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Egypt's Unusual Iron Age: From the Time of Hammering Prestige Goods in the Predynastic Era and Late Bronze Age to Forging the Weapons and Tools of the "Age of Iron"

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EGYPT'S UNUSUAL IRON AGE: FROM THE TIME OF HAMMERING PRESTIGE GOODS IN THE PREDYNASTIC ERA AND LATE BRONZE AGE TO FORGING THE WEAPONS AND TOOLS OF THE "AGE OF IRON"

by

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Dedication

I dedicate this dissertation to my extraordinary son, Alexander Corbett. Ever since you have come into my life you have done nothing but expand it and I love you with all my heart. My husband Brian Corbett gets the bulk of the credit and undying appreciation for years of watching our child, returning library books, printing manuscripts and many other jobs that were as time consuming as they were thankless until now. Special consideration goes to my parents Venice and Tim Carlenius who have always been the most supportive and creative people I have ever known as well as a bedrock for me my entire life. In my younger years my father was also an incredibly talented goldsmith and my mother an excellent helpmate in that regard which was an indirect inspiration for this very work.

All of our family and extended family have been there for me throughout the years as well. I dedicate this dissertation to my brother Mario the artist and his wife Jennifer as well as his children Sienna and Gage who are always close to me in my thoughts. My Aunt Irene Scott, Uncle Roland B. Scott and Aunt Justine Scott have been great, learned examples and cheerleaders throughout this process as well.

In a history department one has the obligation to do the kind of study that provides a deep appreciation for how one’s ancestors have shaped one’s own opportunities and even the nation in which we live. Whether you were slaves, abolitionists (including Frederick Douglass himself, our greatest direct ancestor whom our entire family thanks and treasures to this very hour), to freedmen, tribal Native Americans, musicians, scientists, scholars or the Viking stock from whom my

Finnish/Swedish father descended I owe you everything. My grandfather Roland B. Scott deserves endless gratitude for changing his own circumstances by rising from poverty to graduate from medical school. His illustrious career in medicine and scientific research afterward included becoming the first African American to become board certified in Allergy and Pediatrics. Without those colossal efforts during one of the most trying centuries I doubt I would even be able to read this dissertation, let alone write it. I still recall the encouragement you gave me from the youngest age until your passing.

Finally, I would like to dedicate this dissertation to my other grandparents. Rosetta Scott and Toini Carlenius were universally considered the sweetest, kindest and most beautiful women to their wide circles of friends. Many thanks to Donald Carlenius who was a great and exciting, rakish character according to everyone he ever met including me. Your intelligence, good advice and sense of fun have remained fond memories for me my whole life.

Considering the subject of this dissertation, my final praise goes to the man who worked the iron mines of Sweden only to go to Michigan to do the very same, my father's grandfather Carl. I dare say it was regrettably no easier for you than it was for the ancients in the Roman Empire or Egypt proper since family stories include you having to lift heavy loads and bring them to the seashore by the power of your own back. Your progeny are forever grateful and still benefitting from what you left behind.

Acknowledgments

When people write “all gratitude goes to X, and all errors are mine alone” it is generally thought to be a pleasantry—in fact, I have usually skipped over such sentences and regarded them as mere banalities— but I finally now know firsthand how deeply heartfelt and accurate such statements are. I could not have even begun this project let alone carried it to completion without the steady and brilliant guidance of my advisor, Dr. Suzanne Onstine, to whom every bit of credit goes. She is not only an expert in her field, she also understands logistics and how to conduct projects in ways that few people do. She was the first to suggest and realize that I would be completely enthralled by this subject and helped me avoid many pitfalls (although I found my many on my own). Having the opportunity to look at long term, large scale trends and a sociologically based view of the history of iron in Egypt (and to some extent, its environs) was a true privilege.

Drs. Brand, Podzorski and Corcoran rounded out my amazing committee. When I first realized I would be covering a period of 4,000 years I assumed there would have to be some gaps in expertise among my advisors but because of these particular individuals’ willingness to participate in this project there were none. Every time period and subject including gender studies, archaeology, philology, history, metals science and art had more expertise than I had time to fully access.

Special thanks to Dr. Corcoran for kindly offering to be a part of the committee and her enthusiasm upon doing so since I would have been too intimidated to ask and her participation brought so much to the process. Dr. Podzorski was especially helpful at the

beginning of the project by directing me away from several areas that would not have led to profitable results and leading me towards the directions of lines of research that did provide answers. Dr. Brand has been an incredible professor since my very first day at this university including the most enlightening trip I have ever taken to Egypt as well as providing assistance throughout the production of this work. I only regret that I could not avail myself of my committee's knowledge more and include it to an even greater extent. I am forever grateful for the insights they offered that I was able to incorporate into this text. Again, whatever is lacking is through my own oversights and errors alone.

The dissertation itself rests on the work of giants in their respective fields. Most are acknowledged within the text but there are some scholars who provided personal assistance that I wish to thank as well. Dr. Adam Latjar made me privy to his own unpublished thoughts, communicated to me while he was traveling for which I was so grateful. His discoveries, translations and generosity provided up until the very last week of my work formed the entire foundation for the Roman era section of this dissertation. Without him we would not know about the iron-workers who were by far the most interesting subjects to study.

Dr. Roger Bagnall, director of the Institute for the Study of the Ancient World and Columbia's excavation at Amheida was quite helpful as were his staff including particularly informative assistance and access offered freely by Bruno Bazzani. I was actually able to see all the current bronze and ironwork they have found at the site of Amheida to date thanks to the latter. I expect their work will continue to offer great insights but they are already making their findings more accessible to the public than most. The staffs of all of the museums I was able to include in my database were extraordinary. Dr. Mark Freilich made his last task at this university reading over and offering suggestions and assistance regarding the chemistry portion of my dissertation. That generosity will not soon be forgotten. Finally, I wish to thank Liz Warkentin for facilitating bringing Dr. Boozer to the university (which provided me the ability to see the ongoing work at Amheida) and Dr. Chrystal Goudsouzian for all of her help at numerous steps along the way.

Abstract

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Thus far determining when the Iron Age occurred in Egypt has been an imprecise process with most overviews simply stating when iron first appeared, highlights of iron discoveries or when smelting began in earnest which was the 6th Century BCE in the Delta. In this dissertation I employ Anthony Snodgrass's methodology to determine when it occurred. The results indicate that the height of Egypt's iron use peaked in the Roman era; by the Late Roman era they reverted to using iron for ornamental purposes in much smaller quantities. In addition, iron production may never have exceeded that of bronze which may be a hallmark of a true Iron Age.

Egypt's Iron Age was clearly atypical. After possibly engaging in the earliest known experimentation with iron in the world (around 3300 BCE) they took three millennia before producing a significant number of practical iron goods. Then for some reason they drastically reduced much iron production. Through cross-cultural comparison and an in depth look at three time periods: the Predynastic when iron first appears in Egypt, the Late Bronze Age and Greco-Roman eras, I argue that the fact that iron was never deeply integrated into the fabric of indigenous ancient Egyptian society and crises that occurred throughout the Roman Empire were the causes of the short peak use of iron.

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Introduction and Theoretical Considerations

No matter how one assesses the use of iron in ancient Egypt, it has one of the most confounding and unusual historical trajectories in all of Eurasia or Africa. Even though most scholars in recent years would agree that Egypt was not a significant cradle of iron production, news reports and several studies have confirmed that the earliest known pieces of worked iron in the entire world were actually meteoric beads found in Predynastic Egypt c. 3300 BCE (Johnson, Tyldesley, Lowe, Withers & Grady, 2013, p. 997). In the course of this dissertation we will see that experts disagree as to whether they were cold hammered or heat treated, but later evidence suggests Egyptians may have been capable of leading the technological advances in ironwork once again. The first evidence for the quench hardening of iron appeared in Egypt in the form of a lugged axe head dated to 900 BCE which led a premier scholar of the history of metallurgy to marvel that this was "of the greatest interest" precisely because of the "alleged backwardness" of Egypt (Tylecote, 1976, pp. 44-45).

Nonetheless, ancient Egyptians would not use iron in significant quantities until perhaps the sixth century BCE (at Tell Defenneh and Naukratis) which was *millennia* after its first appearance and at least centuries after they were probably capable of creating hardened forms of the metal. This apparent extremely long time lag between the possible initial experimentation and larger scale adoption of iron technology is completely unique in this part of the ancient world. Then judging by the infrequent appearance of iron in museum collections at later time periods I would argue that just as surprisingly they discontinued using iron in great quantities. Why would a culture that could have been as great an iron producer as any other in Eurasia or Africa 1) be so sporadic in their technological advances, 2) have such enormous time lags between these advances and 3) *discontinue* significant iron production, essentially exiting their "Iron Age" to the degree they may have had one?

Many possible reasons for Egypt's late adoption of iron production and lack of long term interest in iron have been postulated, all of which provide primarily functionalist explanations. The following list of issues produced by Bruce Trigger in the late 1960s is the culmination of no less than seventy-five years of argument and remains a very thorough accounting of the major issues scholars have believed to contribute to Egypt's unique history of iron use: 1) Egypt took 500 years longer than the Sinai to initially become interested in industrial iron because it was at a further distance from Anatolia, the purported place of the invention of an iron smelting technology. That argument seems overly simplistic to some authors because this surmountable distance was an unlikely hindrance to the enterprising Egyptians. 2) Researchers vary greatly in their assessment of the quality of iron ores in Egypt. Some believe that the Eastern Desert and Sinai had good quality ores that were well known from the earliest stages of Egyptian history while other researchers argue that Egyptian iron ores were of poor quality which contributed to the failure to maintain iron production in the long term. 3) Many scholars argue Egypt's famous lack of high quality timber meant that the ancient Egyptians were unable to produce enough good charcoal which was the foundation of ancient iron smelting methods, and 4) some argue that Egypt was so self-sufficient and geographically isolated in comparison to the ancient Greeks and Western Asian populations that they developed a traditional conservatism that did not lend itself to change; for example their adze shapes remained unaltered for 2,000 years. [Trigger, 1969, pp. 32-33]

Aside from the last argument, none of these explanations accounts for the nature of the producers of ancient Egyptian iron, their socio-economic position and the place of iron in the ancient Egyptian mindset. The following complaint by Bruce Trigger holds true today, “One of the major weaknesses of the artistically and epigraphically oriented archaeology that has dominated Egyptian and Sudanese studies until recently has been its efforts to explain its findings in terms of political events, as opposed to social or economic factors” (1969, p. 24). To date this situation has still not been rectified.

I propose that there is a reason for all of the strange and unique characteristics of the ancient Egyptian Iron Age. In this dissertation, I argue that Egypt had an entirely different relationship to iron than some other producers in Eurasia and Africa which essentially began with their introduction to the metal as a found substance of meteoric origins. I believe one of the most important ways we can begin to understand this is by attempting to properly quantify ancient Egyptian iron use and determine the actual chronology of its Iron Age which has never been done so far. How was iron used when it was first discovered? How did its use change over time? When exactly did iron use escalate and when did it begin to dwindle?

To these ends I used the methods for quantifying an Iron Age based upon the work of the renowned scholar of the Aegean (who has also written about other areas of the Mediterranean including Egypt), Anthony Snodgrass. This work will be outlined in the section entitled “The History of Ironwork in Ancient Egypt and Establishing the Chronology and Nature of its ‘Iron Age.’” I surveyed sixty-five museums across the globe which included every one with a significant ancient Egyptian collection and located fourteen with catalogued iron objects that provided dates and descriptions of the objects wherein their functions and provenance could be determined. I then compared their uses, changes of function and relative occurrences over time to make the discovery that the museum collections of the world would indicate the peak of iron use was a Roman era (c. 30 BC-395 CE) phenomenon that then de-escalated shortly afterward. Most surprising was the fact that bronze use peaked at the same time and was apparently used in greater quantity. As we will see, in Snodgrass’s work this might not be a “true” Iron Age which he defines as a time when iron exceeds bronze for practical purposes (1980, p. 337 & slightly different definition in 2006, p. 130[1]). In my view this is an adequate working definition for an Iron Age with some caveats. We will note in the historical section that this definition only works for Eurasia and even then we need to pay closer attention to socio-cultural differences between iron-using populations. Although I do not dispute the idea that the aforementioned list of functional theories had an enormous effect on iron use in Egypt, I will devote much of my efforts to exploring the unexamined socio-cultural factors that may have contributed to their lack of interest in iron as well. When we compare the Egyptians to other cultures like the Bantu we will see that the Egyptians

[1] In 2006 Snodgrass describes the definition of a true “Iron Age” as a time when the economy is substantially based on ironworking and deplores the fact that archaeologists are so loose with their use of the term, employing it for times when cultures merely became familiar with ironworking. This remains a similar problem with ancient Egypt as well.

never became a truly iron-dependant society[2] in the way that the Bantu did early in their history.

At the end of the historical section I describe possible reasons for the discovery that iron use peaks in the Roman era, one of which is the possibility that Egypt had a subdued Iron Age or that it was non-existent in comparison to truly iron-dependant cultures like the Bantu or Greeks. All indications at present suggest that Egypt had a very unusual relationship with respect to many areas of Africa and Eurasia. The argument that I make is that in contrast to some other areas with which Egypt had contact (and even some with which it had little to no contact), Egypt's orientation to iron was fundamentally as an "outside" or "foreign" substance and product. In essence, linguistic, historical and archaeological evidence demonstrates that it was a substance that came from the "heavens" initially. At every stage the use of iron changed with new social conditions but never became well integrated into the deep fabric of ancient Egyptian society in the way other metals like gold, bronze or copper did.

We will survey three different time periods, the Predynastic in the fourth millennium BCE, the end of the Late Bronze Age[3] (c. 1200 BCE) and Greco-Roman era

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[2] "Iron-dependant" in my meaning refers to a culture whose activities such as food production, house construction, war making and other similarly essential tasks rely on iron. I believe the Bantu and Greeks came to be such cultures at different points in their histories while the ancient Egyptians did not.

[3] The terms "Bronze Age" and "Iron Age" cannot be applied evenly across the region which is the entire focus of this dissertation. We will see how Snodgrass determines the transitional point between the two ages and then find that at present I believe the peak of both the use of bronze and iron occurred in Egypt during the Roman era (c. 30 BCE-395 CE) prior to the "Third Century Crises of Rome" for reasons that will be hypothesized in the final section. Nonetheless, it may be useful to note that the "Bronze Age" commenced around 3,000 BCE within centuries of one another in most cultures we will discuss that had one. As we will see in the section entitled the "Late Bronze Age" quite a few cultures transitioned to an Iron Age c. 1200 BCE with Egypt as a notable exception although even this chronology is quite often not on firm ground (see Appendix E for comparative chronologies).

(332 BCE-395 CE) to look at various socio-economic factors which affected the use of iron. We will see that over time evolving mortuary practices, changes in architecture, new forms of ideology, a new form of patron-client system, the rise of a "common person," or "individual," a later end to the patron-client system, the end of the Bronze Age and a period of multiple crises throughout the Roman Empire all accompanied and in many cases directly impacted changes in the trajectory of the use of iron. We also never see iron become deeply integral to ancient Egyptian society even though it does appear to have been capable of enhancing or reflecting social prestige quite early. There is some evidence that the Egyptians may have been keeping abreast of technological advances in ironwork throughout their history although even this idea is inconclusive at best.

In fact, we should note that the absences of evidence for ironwork are often glaring. There are no tomb biographies boasting about one's association with iron production and very little direct evidence for how smelting was conducted in Egypt. There are no known tomb depictions of ironwork as one might easily find in association with gold or copper and even evidence for iron mining is rather scanty although more can be said about the locations of potential iron deposits (Abdel-Zaher & Abdel-Aziz, 2011, p. 38).

During the Predynastic era evidence from the end of the fourth millennium BCE indicates iron was a luxury good used on the small scale for individuals who may have had some kind of social significance. We will see that as far as we know at present, iron was limited to very few burials that have quite unique characteristics indicating iron may have had some sort of prestige value for being a substance that had to be acquired with some effort and possibly at some great distance. Later, in the Late Bronze Age, we will see that iron was a part of the exchange network of the Great Kings of the ancient Near East but does not appear to have been employed in any great quantities at the level of the average household. This time there is accompanying textual evidence that iron had prestige value particularly meant to impress the royal households. At the end of this period most of Egypt's neighbors in the ancient Near East experienced enormous warfare and collapse. I will argue that Egypt's very survival of the Bronze Age collapse c. 1200 BCE that destroyed so many other polities and the resilience of its social structures actually *hindered* it from entering the Iron Age at the same time the collapsed societies did. This argument comes closest to the fourth set of theories that Trigger outlined, that Egypt's cultural conservatism was a factor in its iron use which I will discuss with further specificity and modify.

Finally, when we look at the Greco-Roman era around the third century CE we will see that by the time period when iron was in its height of use there is the first evidence for true iron-workers. Prior to that period there is little evidence for a distinct separate individual dedicated to working iron and perhaps none regarding their social organization. Intriguingly, a few details of the cultic activities of these people can be determined and so can their names. They had Greek names, wrote in Greek and their traditions were at best a Greek-Egyptian hybrid and they clearly were also interested in following Ptolemaic (or possibly Roman) models for organizing their craft guild. I include my new hypothesis about the identity of the god whom the iron-workers were worshipping. I believe it was most likely Imhotep as Asklepios, a "son of Hephaistos" who was the Greek god of iron, volcanism and smithing, although I do also consider the god Amenhotep a very strong second possibility. In fact, it does appear both gods were probably important to the iron-workers. Regardless of which god the iron-workers were visiting, the height of iron use is most closely associated with workers emulating Greek ideals to a demonstrable degree. They were more than likely indigenous Egyptians who were Hellenized with the only other real possibility being that they were Greeks living in Egypt who had absorbed some Egyptian customs. Then as we seek to understand why Egypt *exited* its unique and subdued Iron Age, we will see many disruptions occurred in the third century of the Roman era which probably accounts for the fact that iron use dropped quite noticeably.

Thus, the ancient Egyptians' experience with iron appears to be with a found and often even foreign substance and those who we can directly tie to its production were largely emulating Greeks and were clearly Greek influenced (although some of their customs were indigenous in origin). The ancient Egyptian relationship to iron—often as a found, foreign, luxury, "heavenly," prestige or outside good— is in great contrast to some of the other societies of Africa like the Bantu or Mediterranean like the Greeks but shares characteristics with other societies in the region as well. Nonetheless, the main point remains: iron does not appear to have ever become one of the ancient Egyptians' chief socially significant metals nor one upon which their technological and societal advances heavily relied. I believe this accounts for its peculiar historical trajectory.

The Physical and Chemical Properties of Iron and Ancient Furnaces

The remainder of this dissertation will focus on the history of iron use in Egypt, the movement of iron producing technology through surrounding regions, how societal changes affected iron production, determining the nature of the "Iron Age" (and if there was one), and describing the ancient Egyptians' relationship to iron which I believe was fundamentally different than many other ancient Near Eastern and African societies. Nonetheless, there are some chemical and physical properties of iron itself that had a great influence on how it was used as well.

In our current highly industrialized age dominated by competitive nation-states, international trade organized through very precise agreements and the ability of iron-producing nations to have hosts of scientists and rule-writers organized into regulatory bodies, iron and its close relative steel have come to have many varying definitions. These definitions are set by both national and international regulatory bodies but we can describe some of iron's basic physical properties and how ancient iron objects are identified in the laboratory so that we are able to deduce what technology early peoples were capable of at particular points in their history. Engineers, scientists and metallurgists may also define these substances differently depending on their needs. Archaeologists' working definitions for iron, steel and wrought iron are based on simplifying observations of physical properties, chemical compositions and phase transitions. We will see this process is actually not overly complicated and can provide us a wealth of information about tool and other iron product-making.

At its most basic description, iron is the element that appears in the periodic table with the chemical symbol Fe, the atomic number 26, an average atomic weight of 55.85

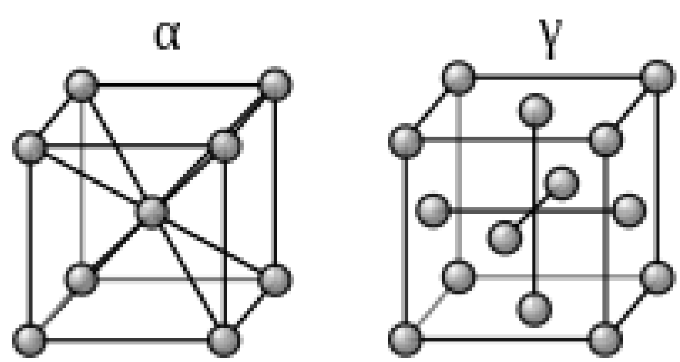
daltons (or atomic mass units, amu), with a density of 7.8 grams per cubic centimeter and a melting point of 1528 degrees Celsius (2782 degrees Fahrenheit) in its pure form ("The Periodic Table of the Elements" n.d.; Wheeler & Maddin, 1980, p. 115).

It is made up of atoms arranged in one of two crystalline patterns called "lattices" that change properties upon heat treatment. We may picture each "lattice" as a cube with points—the atoms— arranged at various parts. (This is the *unit cell* of the crystalline lattice.) When the atoms of iron are located at every corner of the cube with *one sole atom lying at the center of its body*, it is quite logically called a <u>b</u>ody <u>c</u>entered <u>c</u>ubic (therefore, in shorthand it is referred to as having a crystal structure with a "BCC lattice"). Iron arranged in this pattern is termed ferrite, or alpha iron (α-Fe), which is iron in its most natural form. If this iron was treated by an ancient metallurgist at all, it was generally through hammering with little to no heat being applied.

Iron will undergo *phase transitions* under heat treatment, meaning very hot and precise temperatures are required for it to change its crystalline lattice *quite* drastically. When the ferrite form of pure iron is heated to 912 degrees Celsius (1674 degrees Fahrenheit), the atoms migrate into a new unit cell formation where the *center no longer contains a single atom*. Instead, each of the eight corners of our imaginary cube (unit cell) still contains an atom, but now *additional atoms are located at the center of each face* of the cube as well, creating what is known again very logically as a face centered cubic unit cell**,** in shorthand an "FCC lattice." This form of iron is termed austenite or gamma iron (γ Fe). What is significant about this different organization of atoms is that this form of iron is <u>able to absorb more carbon atoms</u> than the BCC form because of all the extra places where the atoms can go. We now know that this extra carbon usually came from heated charcoal in ancient times, a fortuitous event based on the fact that the most widely available fuel for heating the metal was often wood from trees, which happens to be an excellent source of carbon. This rearrangement of the iron atoms into a face centered cubic lattice gives the metal additional strength and the subsequent replacement of some iron atoms by the absorbed carbon atoms from the fuel into the iron (Fe) itself created a stronger, more durable product, a realization that eventually became apparent to the first metallurgists (Bramfitt & Benscoter, 2002, pp. 26-27; see diagram below for why the new product is so much stronger). The introduction of carbon into the crystalline structure may ultimately lead to the production of steel.

Diagram 1

Weaker product on the left (fewer atoms) vs. stronger product on the right (more atoms):



Ferrite, or pure iron in the "BCC lattice" (left cube) has many fewer atoms. Heat treatment creates organizations like austentite in the "FCC lattice" (on the right). The FCC lattice is a much stronger product and is able to hold many more carbon atoms (which replace the iron atoms in the lattice) which came from ancient fuel sources (charcoal) in the fires they used to heat metal. ("Austentite," n.d.)

A Working Definition of Types of Worked Iron: Fe (the element iron) + (percentage of) Carbon

As we have mentioned, while defining iron is actually a very disputable and highly technical process, archaeologists who specialize in studying ancient metallurgy have developed a useful working definition that allows them to differentiate between wrought iron, steel, and cast iron based on focusing solely on the carbon contents which can be measured in a laboratory.

Wrought iron is the element Fe relatively free of carbon meaning that it is iron that was basically hammered into shape without significant heat treatment. When smelting and further processing resulted in Fe with carbon contents of 0.08 percent one has a mild form of steel. A general rule of thumb is that Fe with a carbon content from 0.2 to 0.7 percent can be called steel that has been produced from significant exposure to a carbon-containing heat source. Cast iron exists with about 2 to 4 percent carbon, but it does not appear to have been an important product in ancient Egypt. [Wheeler & Maddin, 1980, p. 115] Therefore, a relatively simple measurement — determining carbon content — tells us what kind of heat treatment the metal has or has not undergone and provides us with important information such as whether or not the culture was able to smelt iron at the forge. Such high heats were clearly difficult for early peoples to achieve because it took centuries or millennia for them to begin creating iron products with significant carbon content.

High Nickel Contents: Evidence for Meteoric Iron

There is another element that iron sometimes contains that can tell us a lot from its mere presence. In the section entitled "The History of Ironwork in Ancient Egypt" we will see that when iron has high contents of nickel, it is generally thought to be meteoric in nature which we will see has been borne out by recent scientific studies. This is interesting because in ancient Egypt they began to call this metal *biꜣ n pt*

 or "iron from the sky" which leads one to wonder if some knowledge of its meteoric origins could explain why it was associated with the king upon his death, apotheosis and movement up to the sky, some of their gods' weapons and bones and with the structure of the heavens itself by the (Old Kingdom c. 2543-2120 BCE). Nonetheless, as we will see when we discuss these issues further in the next section and continuing through to the section that discusses the Predynastic era, it is actually *not* entirely clear that the earliest Egyptians romanticized or attached a high symbolic import to this heavenly metal.

Iron's earliest known associations must have been affected by the fact that it was contained within very interesting, but nonetheless *non-royal* burials of people whom we can identify as probable commoners. The compelling reason the ancients seem to have used meteoric iron was simply that it did not have to be smelted; it could be cold hammered or perhaps even heat treated to some degree but the labor intensive process of extracting it from ore was not necessary. Therefore, much of the first worked iron discovered around the world has been meteoric.

Iron Sources: The Types of Ores

When the people of ancient Egypt and the rest of the ancient Near East began to extract iron from metal-bearing minerals or rocks called "ores" they actually had quite a variety from which to choose. They encountered iron in the following forms: magnetite (Fe_3O_4: a black, granular stone with 72.4 percent iron); hematite (Fe_2O_3: a red to black stone with approximately 70 percent metal); limonite (a general designation for brown, hydrous iron oxides, $FeO(OH)\cdot nH_2O$, where "n" is an integer); pyrite (FeS_2: 46.5 percent iron, which was normally liberated as a byproduct of being worked for its sulfur content); laterite, (reddish, iron rich soils); and goethite ($HFeO_2$: found in the lateritic soils); and gossan which is a reddish colored, exposed iron rock that is in the process of decomposing into iron in the form of goethites and sulfides; chalcopyrites ($CuFeS_2$) and copper-containing ores (Wertime, 1980, pp. 11-12).

The fact that a small quantity of iron can be a byproduct of copper production when an iron oxide flux was used adds much confusion to the study of iron because even significant amounts of iron slag found at sites like Naukratis and Tell Deffeneh in the Delta are sometimes argued to have possibly originated from copper production rather than iron smelting (Ogden, 2000, pp. 166-167).[4] In my view, so many iron tools were

[4] Some authors also stress the *complexity* of iron production in comparison to working other metals including copper as a reason for the lateness in the adoption of the technology. There is also the related argument that different melting points of copper and iron affected the histories of their use. For example, Mirau notes that iron becomes molten at 1537 degrees Celsius whereas copper becomes molten at 1083 degrees Celsius. He states that the much higher temperature required to melt iron was not achievable by ancient smiths. This, in his view, is the reason why copper became the predominant metal in the ancient Near East as an alloy in bronze. With copper and its alloys the ancient smiths could create casts which allowed them to produce utilitarian goods and other items, something they could not do with iron (1997, pp. 101-102). He asserts "usable iron had to be produced in a series of steps that were much different and more complex than the production of copper, lead, tin, silver, gold or even alloys, such as bronze, all of which could be cast" (p. 102).

found at those two sites that it does argue in favor of local iron smelting in the Delta, a point we will explore in depth in the historical overview.

When producing iron, blacksmiths in the ancient Near East and Eastern Mediterranean usually turned to hematite and magnetite. Often a smelting furnace was created by digging a hole into the earth and lining it with brick or clay. The walls could extend above ground or be entirely submerged beneath it. The bottom of the furnace was lined with charcoal upon which the iron ore was placed. The ore was then heated by fire and a blast of air was forced through a clay pipe called a tuyère or a flue in order to obtain the highest possible temperatures. This allowed the charcoal to react with the ore, combining with the oxygen that it contained and "reduce" the ore**,** at approximately 1200 degrees Celsius, to iron while it formed carbon monoxide[5] dioxide gas and sometimes was incorporated into the iron's crystal lattice as well. [Wheeler & Maddin, 1980, p. 115]

In the next section we review the history of ironworking in ancient Egypt. Although very early evidence for iron production is lacking, by the 6th century BCE there

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Ogden echoes this sentiment to this extent, he writes: "The availability of iron on anything but a fortuitous or sporadic scale had to await the development of iron smelting. The relatively late adoption of this technology owes more to the complexities of the processes than to a lack of supplies, since iron ores are actually abundant world-wide" (2000, p. 167). Nonetheless, Ogden sees the temperatures required by copper and iron production as actually only fifty degrees apart from one another (since one could do some ironwork at 1,100-1,150 degrees Celsius) which was achievable by the Egyptians as evidenced by their other metalwork (p. 167).

[5] The facts that ancient smiths were exposed to such dangerous gases and other hazards of the profession bring about interesting questions. Hephaistos who will be treated at length in the final section of this dissertation displays a physical abnormality in the form of a clubbed foot. Since he was born with this affliction and his children had it too it has been argued it was a mythological version of a congenital genetic disorder (Bazopoulou-Kyrkanidou,1997) but one can also argue it could have been associated with their shared perilous profession of metalworking.

is much more information. One hundred and thirty years of excavation and study at Naukratis has revealed a lot about how iron workshops were organized within the community which may give us some clues as to how iron production was viewed. Before that we will see that one generally only has the pieces of worked iron themselves and scanty textual evidence to inform us about the nature of iron production, its producers and how the iron products were employed and viewed.

The History of Ironwork in Ancient Egypt

Overview of the History and Study of Ironwork in Ancient Egypt and Establishing the Chronology and Nature of its "Iron Age"

First stage: metal from the heavens. Why was the ancient Egyptian Iron Age so unique and ultimately out of step with the rest of the Ancient Near East, Mediterranean and Africa? The first uses of ironwork in ancient Egypt were decorative—in fact they are all jewelry— and they appear to have involved "found" iron, that is to say, meteoric iron that had fallen from the sky and was later picked up and worked by the ancients. Afterward it took roughly 3,000 years before the Egyptians developed a recognizable smelting technology. The extremely long period between the Egyptians' possible first experimentation and the time when the metal came into widespread use at some sites is quite unusual in comparison to other polities in the region and beyond. Why the long time lag? Why was this so different from some of their neighbors?

I argue that we first need to understand the iron evidence so far as it has never been organized into a quantifiable scheme that can demonstrate how its frequency of use and general functions changed over time. In fact, there is really no clear cut answer at present as to when the ancient Egyptian Iron Age occurred or if they had one at all. Ogden's entry on iron in *Ancient Egyptian Materials and Technology* provides dates for when iron appears more frequently in Egypt and the ancient Near East but is unable to provide any definitive answers on the matter (Ogden, 2000). Lucas & Harris remark that the date at which iron first came into general use has been fraught with considerable controversy. It was a subject that vexed early Egyptologists, some of whom believed that the pyramids of Giza and other monuments required iron tools in order to be produced. We will return to this topic in the next section, as it is an important subject in the history of Egyptology, but an Old Kingdom (c. 2543-2120 BCE)[6] date for the beginning of the Iron Age is almost surely not the case (1989, p. 236). Lucas & Harris do provide dates for significant finds and impressionistic remarks about when there was a "gradual increase" in iron use (at the end of the Eighteenth Dynasty which had extended from c. 1539-1292 BCE) [p. 239] but nothing more definitive than that. Petrie believed that there had been a "Sporadic Iron Age" in the second millennium BCE because of such discoveries as the iron found in Tutankhamun's Eighteenth Dynasty tomb which we will describe in this section (In Snodgrass, 2006, p. 130).

Others believe that the significant time period when Egypt became true iron-producers was when they first began to smelt iron upon the possible introduction of this technology by East Greek mercenaries and craftsmen (Arkell, 1966, p. 451; Wilson,

[6] Dates provided for Egyptian eras, dynasties and monarchs' reigns come from Warburton, Krauss & Hornung, 2006 with the exception of some contained within the appendix. Dates for the Roman and Greco-Roman eras are broad estimates whose source is listed in Appendix E.

2010, p. 252). Snodgrass similarly argues that it was this date in the 7^{th} century BCE[7] when Egypt became a fully iron-based economy. But everyone who makes this argument does so on the basis of some scanty textual evidence we will describe below, the first known probable presence of smelting facilities and Petrie's early impressions rather than a significant study of the actual evidence (Snodgrass, 1980, p. 266; Snodgrass, 2006, p. 130).

Therefore, we will undertake the project of quantifying the ancient Egyptian Iron Age here. We will begin by describing one archaeologist of the region's tripartite scheme for organizing the data. We will then describe the archaeological and linguistic evidence so far. Finally, we will end this section with my own study of the museum collections of the world using these organizing principles to determine the nature and dates of ancient Egypt's Iron Age.

One of the most influential ways to view iron production comes from noted archaeologist Anthony M. Snodgrass, derived from his expertise in the archaeology of the Mediterranean.[8] He outlined three broad stages that every Mediterranean society underwent in their transition from the Bronze Age to the Iron Age. This is very convenient because Snodgrass's work fits within the general scheme where archaeologists of Eurasia have argued for well over a hundred years that a Stone Age was followed by a Bronze Age and an Iron Age. Snodgrass offers a very applicable scheme

[7] Other scholars claim this occurred in the 6^{th} century BCE, which is the date I have employed throughout this dissertation.

[8] We shall discuss Snodgrass's contributions further under the heading "Eastern Mediterranean: Greece and its Trading Partners."

because it is based on two qualities of the metal that can readily be found in the archaeological record and numerous catalogues and databases today: first, one asks how was the metal used which can often be determined as soon as the shape of the metal is described and second, one measures which metal (bronze or iron) appears more commonly than the other.

In stage 1 Snodgrass found iron was primarily used for ornamentation. It was basically a luxury good not intended for any industrial or tool-like purposes. The iron may have been used with some frequency (although we shall see there is *no* evidence for frequent early use of iron in Egypt in spite of many early Egyptologists' beliefs to the contrary) or even for weapons and tools, but only as decorative objects akin to items appropriate for a "dress uniform" like a prestige dagger (1980, pp. 336-337).

In stage 2 iron's use changes. "Working iron" was produced that was intended for practical purposes, but in demonstrably less statistical frequency than bronze (p. 337). Again, this is something that can be determined by enumerating objects and determining their relative occurrence. What is *so* useful about this method for Egypt is the fact that even when that precise data is not available (since early excavators made a practice of throwing away many metal objects that would never be discarded today), one still has early accounts that describe whether bronze or iron objects were found more often than the other before the archaeologists began purging so many important items. W.M.F. Petrie, who excavated the earliest iron producing sites, did make descriptive notes stating he had found more iron than bronze and in what levels (providing the approximate dates) when that occurred (Petrie, Smith, Gardner & Barclay 1886, p. 39).

Likewise, excavators Rhind and J. Garrow Duncan made similar notations that we will describe at the end of this section under the heading “Roman Occupation” and in the section entitled “Overview of the History and Study of Ironwork in Ancient Egypt.”

Snodgrass’s “Stage 2” would still technically be within the Bronze Age in spite of the fact that experimentation with iron was well underway and a complete change in the character of its use from decorative to practical had occurred. In this case, evidence for carburization, quenching and hardening indicate that a culture had probably entered stage 2 or stage 3 because these are difficult processes intended to increase the utility of the metal (pp. 337-338).

In stage 3 iron production outpaces bronze as a “working metal,” however, interestingly it usually does *not* completely displace bronze (p. 337). “Paradoxically, one of the characteristics of a fully developed Iron Age economy is a rich and varied technology of bronze-working, the quality of bronze artifacts often being dependant on that of iron instruments used in their production” (p. 337).

This is quite noteworthy and significant because when we look at Africa outside the Nilotic region there is no Bronze Age but stone tools are never entirely displaced by iron even when iron’s use became prevalent and widespread. I do have a hypothesis about why one generally sees these technologies continuing after they have become outmoded that is not integral to this dissertation but nonetheless describes why I believe technological skills remain evident in small numbers after the majority of the society has moved on (see Appendix A).

How does this tripartite scheme translate to Egyptian history? Snodgrass saw Egypt as its own "unique case." As we noted in our introduction, Egypt has a strikingly early and prolonged "stage 1." The first iron appears in the Predynastic, roughly 3300 BCE and then according to him Egypt does not enter stage 3 until the 7th century BCE (or 6th century BCE if we are to use the current dating). It is within the realm of possibility, however, that the Egyptians kept up with technological advances in iron production. For instance, in 900 BCE they began to carburize, quench and temper iron. Nonetheless, the frequency of iron use did not outpace bronze and they remained in his stage 2 for at least several more centuries (pp. 365-367).

In my own view, when and if Egypt entered Stage 3, a true Iron Age, is an open question. Certainly the apparent presence of smelting facilities and the impressionistic remarks of excavators that they were seeing more utilitarian iron are significant, but the data for Egypt has not been subjected to this test up until now and I believe that is required for us to have a more definitive answer which is one of the projects of the analysis at the end of this section.

Caveats. No method for systematizing evidence is perfect. The idea of this chronological scheme where ancient societies are said to progress from the Stone Age to the Bronze Age and finally proceed to the Iron Age has many problems. One of the most glaring and also fascinating examples is Japan where agriculture (usually a Neolithic or "New Stone Age" development), bronze and iron all showed up virtually *simultaneously* during the Yayoi cultural revolutions around 300 BCE[9] (Craig, Graham, Kagan, Ozmet &

[9] It may have been within centuries, but within the long view this is still remarkably close in time and either way the argument would be the same.

Turner 2011, p. 262). At the other end of the spectrum, in sub-Saharan Africa and the New World there was no Bronze Age at all. Furthermore, in spite of the fact that sub-Saharan Africa boasted extraordinary levels of sophistication that we will discuss in the following section, the techniques of carburization, quenching and tempering which were so important in the ancient Near East and Europe that they can be used diagnostically by Snodgrass were "rarely applied in Africa in a systematic way" (Blakely, 2006, p. 63).

Likewise, Egypt is no perfect fit for this scheme because they were very late in entering the Iron Age and appear to move away from iron as a utilitarian metal after adopting it. Nevertheless, they were clearly part of the circum-Mediterranean world and at points in their history, such as the 6th century BCE, they were in close contact with that region. I believe Snodgrass's scheme does have diagnostic utility and allows for cross-comparison with continental Eurasia. There are extremely important historical reasons why other areas of the world did not develop similarly, for instance, in the case of Japan incoming populations had reached the Iron Age and brought all preceding developments with them at once or close to it. There were many historical peculiarities that caused Eurasia to develop along the lines that it did including the migratory movements of vast numbers of people that may have precipitated the transition to the Iron Age across the region (Adams, Langer, Hwa, Stearns & Wiesner-Hanks, 2000, Chapter 6).[10]

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[10] The traditional idea that the Indo-European Hittites spread the systematic use of iron and knowledge of ironworking mentioned in this chapter will be challenged in the next section although many authors do still believe it. It appears they probably did not have a monopoly on iron production although a more general idea that massive migratory movements of a number of populations through wars, raiding, re-settlement and the like throughout the region affected the history of iron use at the end of the Late Bronze Age will indeed be explored in the section that follows.

Therefore, as long as one considers this scheme historically specific to continental Eurasia and not a universal pattern of "ages" every civilization should move along as has sometimes been argued, I believe it remains accurate and descriptive of the evidence in many cases. It serves especially well as a means of organizing the data in a compelling way that takes note of when particular technological advances have been achieved which I submit always indicates something interesting has occurred within the society—after all, one has either discovered, borrowed, stolen or somehow otherwise learned something new when a technological advance takes hold. Furthermore, it offers a beginning point for further analysis.

Another primary question is how can we determine when Egypt left the Iron Age and can we determine *why*? Thus far, no one has compiled the more important, significant transitional developments in the Egyptian evidence for ironwork within Snodgrass's framework. Therefore, I summarize some of the Egyptian evidence that will be outlined below in Table 2 in which one can see some of the most important finds and dates during which these different stages were achieved. These discoveries represent the earliest examples of ironwork, when they achieved new stages of development and famous singular examples we will discuss in depth below such as the iron plate found at Giza. One of the caches has what is believed to be an Assyrian style helmet among them and the evidence for smelting has been argued to have arrived with Greek mercenaries which presage a major argument in this dissertation. In effect, although there were evidently some indigenous attitudes and technological advances achieved quite early and throughout Egyptian history, one often detects an outward orientation regarding iron as well. By the Old Kingdom (c. 2543-2120 BCE) we will see evidence that iron was associated with the gods and king, by the New Kingdom (c. 1539-1077 BCE) and probably well prior we have linguistic evidence that it was referred to as a "heavenly" metal. At some of the periods when iron appears to be used in greater frequency at some sites like the 6th century BCE and Roman era around the third century, the individuals producing the iron may have been Greek and/or Greek influenced.

After we look at the existing evidence in depth, we will proceed to my own study of the museum collections that refines this chronology much further. I would argue that a close inspection of the Egyptian evidence generally supports Snodgrass's findings. His theory (summarized in Table 1 for quick reference) offers several insights which allow us to produce the evidence in a format that has been used elsewhere in the Mediterranean, making it helpful for us and other researchers to create general, cross-cultural comparisons across the appropriate regions.

By establishing some of the more salient moments and patterns of the use of iron we can also explore the social implications more deeply. Our primary aim will be to explain why the ancient Egyptian Iron Age was so subdued, filled with vast time lags between transitions and ultimately short in its peak duration.

Table 1

Snodgrass's Tripartite Scheme of the Transition from Bronze to Iron in Eurasia

Stage 1 – Iron is used sporadically for ornamental purposes.

Stage 2 – Iron is used for practical purposes with less statistical frequency than bronze. Carburization, quenching and tempering are often employed.

Stage 3 – Iron use outpaces bronze for tools and weapons. Note that paradoxically bronze use usually continues and may even actually become more advanced in spite of the lower frequency of its appearance. Again carburization, quenching and tempering of iron are in evidence.

Table 2

Egyptian Archaeological Evidence for Iron[11]

Iron	Date	Location	Publication(s)
STAGE 1			
9 Tubular Iron beads	Predynastic c. 3300 BCE	Gerzeh, Tombs 67 and 133	(Wainwright 1938; Coghlan 1977, pp. 5-6; Stevenson 2009, pp.195-198; Johnson et al.,2013), those part of Johnson's analysis are currently held in Petrie Museum (UC80628; UC 80629; Manchester Museum; Rehren, 2013)
Iron ring	Believed to be Predynastic, lost before analysis was possible and prior to any estimates for dating.	Armant, Cemetery	(Mond & Myers 1937, p. 117 and PL XLIII)

[11] See Lucas & Harris, 1989, pp. 237-239 in addition to citations included.

Iron	Date	Location	Publication(s)
Iron sheet	Possibly 4th Dynasty, c. 2543- 2436 BCE This date is in dispute.	Great Pyr. at Giza	(Howard Vyse & Perring, 1840, pp. 275-276)
Iron oxide belonging to a "magical set" found on a flint wand (analyzed spectrographically by W.J. Young, no nickel and therefore not meteoric)	Fourth Dynasty c. 2543- 2436 BCE	Menkaure Valley Temple at Giza	(Reisner in Dunham & Young ,1942, pp. 57-58; Coghlan, 1977, p. 43)
Iron chisels	Fifth Dynasty c. 2435-2306 BCE	Saqqara	(Olshausen, 1907, pp. 373-374)
Iron pickaxe (in pieces)	Sixth Dynasty c. 2305-2118 BCE	Abusir p. 296)	(Maspero, 1883),
Broken tools	6th Dynasty c. 2305-2118 BCE	Dashur	(Petrie, 1909, pp. 104-105)
Iron rust (found with copper adzes of 6th Dynasty type). No nickel therefore probably not meteoric	6th Dynasty c. 2305-2118 BCE	Found-ations of temple at Abydos	(Petrie & Griffith ,1903, pp. 32-33)
Iron or copper-iron alloy beads	Old Kingdom c. 2543-2120 BCE- First Intermediate Pd c. 2118-1980 BCE	Armant	(Mond & Myers, 1937, p. 84)

Iron	Date	Location	Publication(s)
Pesesh-Kef amulet w/silver head and iron blade 10% nickel therefore meteoric	11th Dynasty c. 2080-1940 BCE	Deir el-Bahari Tomb of Princess Aa Shait	(Waldbaum, 1980, p. 71; Coghlan, 1977, p. 6)
Iron chisel and Maspero (1883), part of ferrule of a hoe handle	17th Dynasty c. ?-1540 BCE	Pyramid of Moham-merieh near Esna	(Maspero, 1883, p. 296)
7 iron objects, 6 of which are gold plated	18th Dynasty c. 1539-1292 BCE	Mentioned in Thutmosis III inventory at temple in Qatna	(Coghlan, 1977, p. 42)
Iron arrowhead or Javelin-head with elongated triangular point and long, slender tang	Amarna Period (Akhenaten r. c. 1353-1336 BCE	Palace of Amenhotep III at Thebes, residence of Akhenaten	(W.C. Hayes, 1953, p. 255)
Iron dagger, Miniature iron headrest, Amuletic eye set in gold bracelet, 16 implements with full sized handles but blades so thin Wainwright believed they were magical implements for Opening of the Mouth ritual	Late 18th Dyn which extended from c. 1539-1292 BCE	Tutankh-amun's tomb	(Carter, *Tut-ankh Amen*, Volume 2 Republished in 2010)

Iron	Date	Location	Publication(s)
Iron sickle	Probably Late 18th Dyn which extended from c. 1539-1292 BCE	Under a sphinx of Horemheb Karnak	Discovered by Belzoni. Located at British Museum (EA5410, acquired in 1821: purchased from Henry Salt)
Iron bracelet (Petrie was surprised by the early date)	Dynasty 19 c. 1292-1191 BCE or Dynasty 20 c. 1190-1077 BCE	Tell er-Retabeh Tomb 8	(Petrie, 1989 [1906], p. 32 & Plate XXXIV)
"Some iron"	Dynasty 23 c. 730 BCE to 26th Dyn. c. 664-525 BCE	Cemetery of Goshen	(Petrie & Duncan 1989 [1906], p. 39)
Group of iron tools found w/Assyrian style helmet (significant for introducing the question of the origins of ancient Egyptian ironwork, see Appendix B Figure 2)	End of 25th Dyn. (which extended from c. 722-655 BCE)	Thebes	(Petrie, 1897, pp. 18-19)
STAGE 2			
Lugged Axe head (1st evidence for quench hardening)	900 BCE	Unspecified	(Coghlan, 1977)

Iron	Date	Location	Publication(s)
POSSIBLE STAGE 3 (Snodgrass, Arkell, Wilson and others would place it approximately here, impressionistic remarks by Petrie would support this as a possibility)			
Tools & Weapons (significant for first evidence for smelting, possibly in association with Greek mercenaries)	6th Century BCE	Naukratis	(Petrie et al. 1886)
Tools & Weapons (contemporary w/ first evidence for smelting, possibly in association with Greek mercenaries)	6th Century BCE	Tell Defenneh	(Petrie, Murray, Griffith, Hügel & von Freiherr, 1888)
Iron bracelets	Roman	Yehudiyeh	(Petrie, 1989 [1906], p. 19 & Plate XXI A no.s 57 and 58)
ANOTHER POSSIBLE BEGINNING POINT FOR STAGE 3: (based on impressionistic remarks by excavators)			
Iron knife in leather sheath Iron swords, buckles,	Roman	Cemetery of Goshen Grave 292	(Petrie, 1989 [1906], p. 43)
Hooks & Nails Significance: “bronze was relegated to ornamental purposes, and iron was taking its place among the more useful and practical ends of life”	Roman Burials including swords may have belonged to Roman mercenaries according to Petrie	Cemetery of Tell Yehud or Gheyta	(Duncan 1989 [1906] pp. 58-59)

Iron	Date	Location	Publication(s)
Rod of a steelyard	Roman, "pagan" in Meyer's terms	Armant in the Coptic town	(Mond & Meyers, 1940a & b PL XXXI, fig. 4)

The History of Iron and its Study so Far

There are some excellent overviews of the significant finds of iron products in Egyptian history, especially, Lucas & Harris (1989) and Ogden (2000) but few if any that describe the evidence and the surrounding patterns of production thoroughly. This review summarizes the most important finds in greater detail from the Predynastic c. 3300 BCE to the Greco-Roman period (332 BCE-395 CE) and the major issues that have informed the study of these iron products. A century of archaeological, linguistic and laboratory analysis has established that the first iron specimens were meteoric in nature. Iron discoveries are then sporadic until our first evidence for an "industrial" use of the metal that occurs in the sixth century BCE which includes the first evidence for separate production areas as well.

Using Snodgrass's scheme, I argue we can add further important characterizations of the nature, time frame and patterns of use of the entire Iron Age. As we will ultimately see by the end of this section, I will argue that the Egyptian Iron Age was a particularly muted phenomenon. Although its beginning was exceptionally early, its peak was both short-lived and not as robust as the Iron Ages of other iron-producing cultures. It will then be the project of the remainder of this dissertation to compare the Egyptian experience with iron to other regions and then look at three specific time periods to determine iron's social value and how that changed over time.

What is known about iron between these eras comes from site reports, a few significant laboratory studies and a review of the linguistic evidence which has a particularly long history. What we see below are the most important discoveries so far although there are sure to be many more to come. Altogether, they do also fit within Snodgrass's tripartite scheme which is the foundation for our understanding of its social value in the final three sections of this project.

Iron in the Predynastic

In 1911 Wainwright recovered and published what remains the earliest known examples of Egyptian ironwork, in fact what are still the oldest examples of ironwork found anywhere in the world. Nine 5,000 year old hammer-worked, tubular shaped iron beads were discovered in a prehistoric Gerzeh cemetery 50 miles (80 km) south of Cairo. There were two groups of beads altogether from two different graves, numbers 67 and 133 (Wainwright, 1938).

Both graves show no evidence of looting and therefore are securely dated to Nagada IIC-IIIA c. 3400-3100 BCE (Adams, 1990, p. 25; Stevenson, 2009, pp. 11-31; Rehren et al., 2013, p. 4786). Three elements of this discovery were surprising: first, we see ironwork present in Egypt before they were a unified state or invented hieroglyphic writing. The objects may have been objects of trade or else were products of some restricted experimentation. As noted above, the extraordinarily early, Predynastic date of the first ironwork in Egypt did *not* become part of a widespread, functional technology.

Another rather surprising occurrence was Wainwright's subsequent prescient and clever analysis that offered the early suggestion that this iron was meteoric in nature. Could this have contributed to its use as a prestige metal? The ancient Egyptians seemed to have become aware of the metal's heavenly origins although what that meant to them and exactly when they came to this realization are extremely difficult to ascertain. Nonetheless, we will see that linguistic evidence provides tantalizing clues.

The Beginning of Looking at High Nickel Contents (Especially 5-10% Nickel) in Iron Products as Proof of their Meteoric Origins

Wainwright was quite early in realizing that these first examples of iron were probably meteoric. He actually used a number of methods to come to this conclusion, the first of which was the analysis of nickel contents for as we have already noted, generally higher nickel contents are only seen in meteors and they are not expected in smelted iron.

The discovery that the process of measuring nickel content was useful was established by the early 1900s. Wainwright was able to rely on the findings of several researchers including C.H. Desch whose work for the Sumerian Committee of the British Committee of the British Association included showing that one of the oldest Egyptian beads was 92.5 per cent iron and 7.5 nickel (Wainwright, 1932, p. 3). This high nickel content fell in the average range for known meteoric iron. Desch and Wainwright based this supposition on a study by Zimmer that showed 75 per cent of 287 meteorites had nickel contents between 5 and 10 per cent[12] (Wainwright 1932, footnote 3). Wainwright then added very strong physical circumstantial evidence to this argument. He produced a

[12] Although most examples fell within the 5-10% range of nickel, extreme outliers produced nickel contents well over 50 per cent or hovering around 1 per cent (Wainwright, 1932: footnote 3).

cross-cultural comparison that demonstrated that many early peoples used meteoric iron well before smelting technologies were available anywhere. He also showed that historical descriptions demonstrated that meteorites that had fallen in Egypt and were collected and saved for later use proving that it could have happened earlier as well. His review of the literature of ancient Egypt demonstrated that the mythology and hieroglyphic renderings of iron held clues about its early use too (Wainwright, 1938).

Surprisingly, scientific studies actually created uncertainty about these early beads' meteoric origins before again making the matter clear. By 1995 a study by the Petrie Museum of Egyptian Archaeology University College London seemed to shed doubt on the celestial origins of these pieces and throw the entire issue into confusion. An electron microphobe analysis of surface material scraped from the beads found limonite with *very little nickel content* (which would indicate it was not meteoric) and some traces of copper. This doubt spawned a re-analysis by a multidisciplinary team of researchers who believed that the beads' museum preservation methods and the presence of a copper harpoon in tomb 67 had contaminated the results.

In 2013 this team published the results of subjecting one of the beads[13] from tomb 67 to scanning electron microscopy and X-ray microcomputer tomography. The tomb had contained one body described as a "fair sized boy" arranged on his side in a contracted position. Some of the beads had been located at the body's head around the neck and others including this bead were located at the body's waist (Johnson et al., 2013, pp. 998-999). The bead's composition was found to be 4.8 percent nickel (47.5%

[13] The 1.8 cm long bead in question is from Gerzeh tomb 67 and held in the Manchester Museum collection, accession number 5303 (Johnson et al., 2013, p. 998).

iron and 42.9% oxygen) which placed it right at the lower end of the amount expected for meteoric iron. The definitive proof, however, came from the fact that the nickel rich sections were organized into bands known as the Widmanstätten pattern, long accepted as proof of meteoric origins[14] (Johnson et al., 2013, p. 999-1000). The team further argued that the beads had been cold-worked in order to reach their present shapes (997ff.).

A second team of researchers coordinated by Thilo Rehren, Marcos Martinón-Torres and Zsolt Kasztovszky produced another multi-analytical study on the same group of beads and corroborated some of these results in the same year, 2013. This team used slightly different criteria for proof that the iron came from a meteor. The Widmanstätten pattern and elevated nickel content were expected along with a third characteristic, large crystal grain sizes although the authors were not able to prove those existed due to the condition of the beads (Rehren et al., 2013, p. 4787). Three beads held at the UCL Petrie Museum of Egyptology[15] which all evidenced the rust-brown color expected of heavily corroded iron were subjected to several noninvasive procedures. Prompt-gamma activation analysis (PGAA or PGNAA) produced levels of germanium no different than that of smelted iron but were appropriate for meteorites under their conditions which included a crystal with high levels of germanium itself.

[14] This is only true of cold worked objects, however, which is why this identification is only useful for early Egyptian iron. Working iron above 1000 degrees Celsius can result in the loss Widmanstätten pattern and creation of martensite (Photos, February 1989, pp. 406-407).

[15]The three beads in question were bead UC 10738 (1.5 cm long X 1.3 cm in diameter), bead UC107409 (1.7 cm X .7 cm) and bead UC10740 (1.7 cm X .3 cm) (Rehren et al., 2013, p. 4797).

How the Beads were Made

Neutron radiography produced the most important find of the study: remarkable images showed that the beads were produced by creating thin sheets of iron that were intermittently annealed and then rolled into a bead with a central hole for stringing. We will see this evidence for how the beads were produced—creating thin sheets and rolling them into the bead form— is a highly significant method that we will re-visit in the section that addresses the Predynastic era. The ability to create thin, hammered sheets occurs in all of the places where scholars argue the Egyptians (or whomever were producing the beads) might have been acquiring their metallurgical skills, both outside and within Egypt.

This second group of researchers also argued something that no one else has: they believe that the Egyptians were *heat-treating* the beads by annealing the sheet metal and beating it (pp. 4787-4789). This leads them to believe another point that no one has suggested so far: they argue that the ancient Egyptians' first ironwork provided the skill set necessary for them to become good iron smelters 2,000 years later. The importance is outlined in their abstract.

> This is of wider significance as it demonstrates that metalworkers had already nearly two millennia of experience to hot-work meteoritic iron when iron smelting was introduced [in the New Kingdom]. This knowledge was essential for the development of iron smelting, which produced metal in a solid state process and hence depended on this ability in order to replace copper and bronze as the main utilitarian metals. [p. 4785]

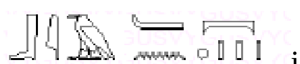
This is important because it is often argued that the New Kingdom (c. 1539-1077 BCE) iron in Egypt was not produced by Egyptians; it is often thought to have originated in Western Asia. Could there truly be an indigenous or at least very ancient origin to

Egyptian smelting advances? This would be important news indeed. I have used the argument they began smelting in significant quantities in the 6th century BCE for this dissertation but I do not rule out that it occurred earlier. We will see that other researchers like Waldbaum provide good arguments that the latter was the case and that there are some early examples of iron that may have been smelted in Egypt prior to that date. Either way, in spite of the Egyptians' demonstrable metallurgical skills they do not appear to have become iron producers in great quantity by the New Kingdom as we will establish more thoroughly below. It is nonetheless certainly fascinating that they could have. Again, this will be an ongoing question. Were the Egyptians simply limited by technological factors like little access to wood for charcoal or little iron ore itself, or were there sociological reasons as well?

Their study was also important for measuring the nickel contents slightly differently than other studies and confirming what has become a subject of so much scholarly interest. Was this iron meteoric? The nickel contents for the beads would correlate to 6-9% nickel in the original, non-corroded form (perfect for meteoric iron) (pp. 4788-4789). The researchers who conducted this second study agree that on balance their results were consistent with a meteoric origin for the earliest Egyptian iron (p. 4790), thus one hundred years of speculation, research, testing and study appear to support Wainwright's original conclusion. The earliest worked iron found in Egypt, and so far the world, came from the heavens. What is the significance of these meteoric origins and what did it mean to the ancient Egyptians?

Linguistic Evidence that Egyptians Knew Early Iron was Meteoric

As we mentioned, the original archaeologist to discover these finds, Wainwright, used multiple methods to determine early Egyptian iron was meteoric. One of the others was linguistic evidence. The study of the derivation of words for iron is so important that many scholars have written extensively on this subject alone. Unlike many other areas of the world, any treatment of ancient Egyptian iron has to acknowledge the linguistic studies and their long history. Egypt is fortunate because the language offers linguistic and pictorial evidence at once because of the hieroglyphic script, something found in a few other cultures regarding iron (in Mesopotamia, more on this later) but is relatively rare in the history of the world.

It has taken a long time for scholars to agree that the word *bỉꜣ* and phrase *bỉꜣ n pt*  indicated iron to the ancient Egyptians although *bỉꜣ* may have had a wider application as well.[16] In 1868 Rev. Basil H. Cooper published a paper titled "The Antiquity of the Use of the Metals and especially of Iron, among the Egyptians" in which he noted that the contemporary Coptic Egyptian word for iron in the Sahidic dialect, which he believed was the closest to the ancient Egyptian, was *Benipi* or *Benipe* (with the initial "b" sometimes replaced by a "p"). The first element, BA or BE (BO in another dialect) meant "hard wood" or "stone" which was often accompanied by a depiction of a squared stone in the hieroglyphic inscriptions. The middle syllable "NI" corresponds to the English preposition "of" and the syllable PE is the Coptic word for "sky" or

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[16] *bỉꜣ* was also associated more generally with "wonders" or "marvels" (Faulkner, 1962, pp. 80-81).

"heaven." Thus the Coptic word for iron's literal meaning was "stone of heaven," "stone of the sky" or "sky-stone" which Cooper argued indicated meteoric iron, "the only Iron with which men were likely to meet in a natural state." [In Day, 1877, pp. 40-43]

> In short, we may be sure, especially with the light thrown on the matter by this invaluable Egyptian word, bright with the radiance of that heaven which enters into its composition, that with this wondrous matter from another sphere than our own the working of Iron began. [p. 43]

Brugsch, Dévéria, Daressy, Spiegelberg, Gsell, Ball, and Sayce all made arguments that correlated the Coptic and Egyptian phrases and/or postulated that the first iron was meteoric (In Harris, 1961, p. 59). As early as 1885 F.G. Hilton Price stated the following: "There are two words known descriptive of iron, *ba en pe*, 'heavenly metal,' supposed to be meteoric iron; and *ba nu ta*, or 'terrestrial metal,' that found in the earth" (p. 60). Today this would be transliterated as *bỉꜣ n tꜣ* and *bỉꜣ n pt* and translated as "iron from the earth" and "iron from the sky/heavens." What is curious about these epithets is that they do not appear until the New Kingdom, around approximately 1320 BCE, roughly 2,000 years *after* this "heavenly," meteoric iron was already in use in Egypt (Bjorkman, 1973, p. 114 and Johnson et al., 2013, p. 1003). Nonetheless, could the ancient Egyptians have been aware of iron's meteoric origins far earlier?

Wainwright offered one of the best constructed arguments in 1932 in favor of their pre-New Kingdom knowledge of iron's celestial origins. He believed the pictorial elements within the linguistic evidence offered proof the Egyptians became aware of the meteoric origins of iron well before they began to designate some iron's heavenly origins. He also believed one could find clues within the Pyramid Texts, some of the earliest mythological works that survive. Wainwright's arguments are useful for the purposes of this present study as well because they provide our earliest evidence for how the Egyptians actually perceived the metal, the symbolism being crucial if we are to understand its social value.

Wainwright argued that the Pyramid Texts may not have provided any specific and clear references to the meteoric origins of iron, nor did they refer to a related "bursting power" of lightning that he believed early peoples like the ancient Egyptians associated with meteors that they witnessed falling from the sky. Even so he found it significant that iron was intimately tied to the heavens. The gates and vault of heaven were said to be comprised of *bἰꜣ*, the throne of the deceased pharaoh and his scepter were iron and his very bones and limbs were also transformed into *bἰꜣ* upon his apotheosis in the afterlife (Wainwright, 1932, pp. 8 & 11 and for the original texts see PT 907, 1575, 305, 1121, 736, 770, 1563, 530, 1454, 2051 & 749). Both the god Seth's *mtꜣyt*-spear[17] that he used to protect the barque of the sun-god from the evil snake and his brother Horus' weapons were also produced of *bἰꜣ* (p. 13). In the afterlife the king would descend from Horus' arms on bands of iron (PT 138). Furthermore, the ceremonies that would enliven the king in the afterlife included the Opening of the Mouth[18] performed with an adze of iron made from Seth's bones (p. 14 and PT 14). Iron was a metal intimately associated with the gods, heavens and the deified king.

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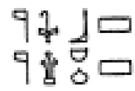
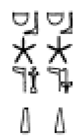
[17] Also translated "lance" or "skewer" (Vygus, 2009, p. 315) but clearly meaning a weapon.

[18] The ritual comprised of a series of actions and utterances designed to bring about the sensory capabilities of a cult statue or mummy so that it could partake of offerings of food and drink meant to sustain it. The first known evidence comes from the pyramid of Unas, preserved on the first register, spells 16-40 (Roth, 1992, p. 113 & footnote 6).

Wainwright noted that the Coffin Texts of the First Intermediate Period (c.2118-1980 BCE) offered significant clues that the Egyptians began to associate iron with meteors contained within the way they wrote the words for iron. The Old Kingdom (c. 2543-2120 BCE) rendering for iron appeared in the following manner in the Pyramid Texts:



In the First Intermediate Period this was replaced by either of the following two forms of the word:

 or 

Note the prominence of the insignia for *a star* in both of the latter First Intermediate Period renderings. Wainwright argued that this was after they had written about a class of stars that were seen to fall from the sky with terrible or magical consequences.[19] Nonetheless, in the New Kingdom (c. 1539-1077 BCE) a significant change occurred again, for the first time the epithets mentioned above appeared which leaves us to wonder what was the reason for this new distinction between iron from the earth and iron from the sky?

In 1961 Harris compiled all of the data and scholarship up until that point for his comprehensive *Lexicographical Studies in Ancient Egyptian Metals*. There is very strong

[19] Mentioned in *The Shipwrecked Sailor*, we will return to this reference in the discussion of meteorites in Mesopotamia.

evidence that “iron from heaven” was used in the same way *biꜣ* had been used. For instance, a term that Harris argues had to refer to imported, smelted iron that came from a part of modern Syria was designated as being from the heavens, *biꜣ n pt n Rṯnw* (literally “iron from the sky of/from Syria”). Therefore, it seems to have been used to reference all iron, not simply meteoric iron. There was a significant change occurring at this time. At the very moment that the new epithet “iron from the heavens” appeared the Egyptians were first coming into contact with smelted iron, possibly from Western Asia (p. 60).[20] Perhaps, then, this distinction between types of iron was related to a desire to distinguish meteoric iron from the new products of foreign smelting technology.

More recently, Aufrère has considered a related idea proffered by Harris that is reminiscent of Wainwright. Harris proposed that the weapons of Horus and Seth were actually shooting stars or thunderbolts and that the ropes upon which a king would travel between the heavens and earth could be regarded in the same way. Even though he admitted this idea was quite attractive, Aufrère believes this idea to be without any basis in real evidence (1991, p. 433).

Later in the Coptic period *biꜣ n pt* was replaced by the word ⲂⲈⲚⲒⲠⲈ that had the same meaning as texts about the “Opening of the Mouth” ceremony. Since this word is known to mean iron it provides further evidence that the derivation of *biꜣ* described above is correct. Alternatively, the term “iron from the earth” *biꜣ n tꜣ*

[20] New Kingdom iron is often believed to have come from Western Asia. For instance Partridge writes “It is virtually certain […] that the large-scale, commercial smelting of iron originated in Asia” (2002, p. 26) but we will see that it is also possible the Egyptians were creating important iron pieces on their own at this time or at least shortly afterward, in the Amarna period so currently both arguments remain plausible.

 is so infrequent (only one or possibly two mentions known at the time[21]) that Harris suggested it was simply an artificial creation to balance out the term *biꜣ n pt*, presumably because of the ancient Egyptians' famous attraction to symmetry, order and dualisms. [Harris, 1961, pp. 58-60]

Therefore, linguistic evidence demonstrates that the ancient Egyptians ultimately appear aware of iron's heavenly origins and considered it a substance in some way related to the gods and kings. However, how much did they really integrate it into their overall society at this early date? As we will see below, there are very few examples of early iron from this time period and they are separated widely in time.

Early Iron in the Predynastic through Old Kingdom eras: The Cemetery at Armant and Old Kingdom Pyramids

To return to the general outline of the history of iron from the archaeological evidence, there was another Predynastic iron object found at the cemetery of Armant. This was a "heavily oxidized" ring. It was found in association with two copper bangles and is believed to be dated to the Predynastic era. Unfortunately, it disappeared on the way to being analyzed and therefore whether or not it was meteoric like other early Egyptian iron could not be determined (see Appendix B, Figure 1; Mond & Myers, 1937, p. 117 & PL XL III; Lucas & Harris, 1989, p. 237). This disappearance is especially disheartening for this study because later Old Kingdom (c. 2543-2120 BCE) or First Intermediate Period (c. 2128-1980 BCE) iron or iron-copper alloy beads were found at the same cemetery (Mond & Myers, 1937, p. 84; Lucas & Harris, 1989, p. 238). Later in

[21] Thes. 1375 and Lib. Fun I 127 (Harris, 1961, footnote 5).

the Greco-Roman period around the third century CE a group of iron-workers from Armant left significant inscriptions behind at the temple of Hatshepsut at Deir el-Bahari. These enticing but chronologically scattered clues suggest that ironworking could have had a millennia long history in this ancient town—in fact the longest history anywhere in Egypt that with any evidence at present— but whether it was sporadic or continuous is left to conjecture.

This is where Snodgrass's structure is so helpful for us. Based on Snodgrass's stages I would argue it is probable that ironworking was conducted sporadically in Armant along the general timeframe suggested by his tripartite scheme. They were probably experimenting with it when the opportunity presented itself but only on occasion for millennia which would account for the extremely small quantities of the discoveries so far. Perhaps they came across a meteorite that had fallen somewhere near their town, or maybe they traded for an iron object from some other population. At some point in the Greco-Roman era (332 BCE-395 CE) that appears to have changed. At that point by the third century CE ironworking was a well organized profession and an interesting one as well. At this later stage we will see the iron-workers were organized into a communal group that not only worked together, but also celebrated some sort of religious cult practices together on a rooftop of an ancient temple complete with their own beer brewer. We shall have much more to say about the Greco-Roman social organization of ironwork in the final section of this study.

To return to the history of discoveries of iron in the rest of Egypt, after the Predynastic era around 3300 BCE other sporadic discoveries have made it appear that there may have been some ironworking in Egypt or importation and iron use in the Old Kingdom (c. 2543-2120 BCE) as well. The earliest possible example of these is an iron plate that was found within the 4th Dynasty (2543-2436 BCE) Great Pyramid at Giza by Colonel Howard-Vyse on May 26th, 1837.

The events surrounding the discovery of this single, unique, and to some minds "advanced" iron plate has spawned much discussion. Endless popular alternate history aficionados have seen this as proof of the "Atlantean" origins of the Egyptians' technology and culture, others have seen it as proof the Egyptians were employing iron regularly to produce the early, great architectural wonders for which Egypt is famous including the pyramids. The exact arrival of each of the witnesses to the discovery of this marvel have been studied, reviewed and repeated at length. In fact, the story is rather revealing but not in the way some of the more outlandish theorists would admit.

In 1837, when good archaeological practices were often nonexistent, Colonel Howard-Vyse's associate J.R. Hill used explosives to remove the blocks from the southern face of the Great Pyramid itself near the mouth of the shaft at the king's chamber and when the smoke cleared he found a flat iron plate measuring approximately 12 X 4 X 1/8 inches and they marveled at this discovery. About a month later, on June 24th, John Shae Perring was shown the site where the piece of iron was found. Hill wrote a letter verifying its authenticity to the British Museum, mentioning that he had shown the location to Perring and providing the institution with the object where it is housed to this day. Perring provided his own letter to the British Museum stating that he believed the iron must have been created at the time of the pyramid's construction. Two days later, witnesses Ed S. Andrews and James Mash certified the same.

In spite of this substantial number of letters of authenticity, this actually leaves Howard-Vyse and Hill as the only named true witnesses to the discovery, with only Hill providing his very brief explanation that he had found the object and believed it was contemporary to the building of the pyramid. The other individuals arrived over a month later and simply added their testimony after being shown the place where the object was found. No other documentation—field notes, photographs, drawings or any other evidence provides an accurate record of the find spot (Rigano, 2014 pp. 33-34). One author who has studied the subject named Rigano complains, "While this may have passed for science in 1837, it falls short of a creditable account today" (p. 34).

Therefore, it should not surprise us that the veracity of the find has been in dispute since its discovery with many scholars weighing in on whether or not they believe the iron was ancient or a more recent intrusion that could have entered the site by being dropped by one of Howard-Vyse's own workers, from an earlier tourist, or having fallen between the pyramid's blocks during earlier Arab exploration at the site. Arguably some of the most important experiments to have ever been conducted on ancient Egyptian iron have sought to understand this single specimen.

A 1989 examination of a 1 cm fragment conducted by El Gayar and Jones confirmed earlier reports that the object had very low nickel content—and therefore must have been smelted, not meteoric. Again, as we mentioned in section II, this normally requires very high temperatures and a very advanced smelting technology. How could this have been present in the Old Kingdom (c. 2543-2120 BCE)? The study concluded that the plate was comprised of laminates of iron welded together "inexpertly" by hammering without copper globules, meaning it was not a byproduct of copper smelting but also suggesting an ancient culture produced the object. There were a large number of inclusions and a small but significant amount of gold was recovered from an outer layer. The researchers concluded this was ancient iron that may have originally been gold plated (pp. 75-83).

A later 1993 analysis by Craddock and Lang using a scanning electron microscope and X-ray fluorescence of a new section of the iron plate found no gold, but otherwise a similar structure. In their interpretation the inclusions indicated manufacture that was "careless maybe, but not primitive" and probably belonged to the post-medieval Islamic period (pp. 57-59). Therefore, the evidence regarding this unique find is still open to varying interpretations. We cannot even be sure it is from the Old Kingdom and given the absence of any evidence for the kinds of workshops we will see appearing in the 6th century BCE it is hard to determine how, when (and if) this iron plate was lodged in between the large blocks of the Great Pyramid.

The other Old Kingdom finds include several with low nickel content, again, a great curiosity given the fact that there is no archaeological or clear pictorial evidence for early iron smelting.[22] Reisner found a small piece of iron from a "magical set" dated to the 4th Dynasty (c. 2543-2436 BCE) of that era that had no traces of nickel. Maspero found 5th Dynasty (c. 2435-2306 BCE) fragments of chisels from Saqqara, 6th Dynasty

[22] There was much debate about this among earlier Egyptologists, many of whom argued that there were pictorial indications that iron was used throughout most of Egyptian history, but this appears to be incorrect. We will cover this subject at some length in the next section.

(c. 2305-2118 BCE) pieces of a pickaxe found at Abusir, and broken tools from Dashur which he also claimed to be from the 6th Dynasty. Regarding these items discovered by Maspero, Lucas & Harris found the dating questionable since the references to their discoveries were all “vague and unsatisfactory” (1989, p. 238). In the foundation of a temple at Abydos, Petrie found some iron rust with no nickel content in association with copper adzes he believed to be from the 6th Dynasty. Lastly, there are the previously mentioned beads from Armant from either the Old Kingdom or First Intermediate period (c. 2128-1980 BCE) that were either iron or a copper-iron alloy (Lucas & Harris, 1989, p. 238).

All together, from the first piece of iron to the last that has been dated to the Old Kingdom (c. 2543-2120 BCE), the examples are fragmentary, separated widely in time, and sometimes questionable with respect to their dating and function. The picture generally fits one of Snodgrass’s experimental phases (stage 1) but with some caveats. In the minds of many researchers there is the possibility that the ancient Egyptians were doing some smelting or alternatively using imported smelted iron. Sites that have produced iron with no nickel contents at very early dates outside the Egyptian sites of Giza and Abydos are Samarra in modern day Iraq from circa 5,000 BCE. Other sites with similar evidence that are roughly contemporary to the Egyptian evidence from the third millennium BCE are Tell Asmar and Chagar Bazar in Mesopotamia and Alaca Höyük in Anatolia (Waldbaum, 1999, p. 30). With two sites in Egypt producing low nickel iron and several outside Egypt also producing such finds either argument remains a possibility.

References to iron in the *Pyramid Texts* allow us to surmise it had connotations associating it with the heavens, the gods and the king upon his apotheosis. However, the fact that so few Old Kingdom examples of iron exist makes the argument that the Egyptians were using smelted iron at this early date in large quantities highly unlikely. So far no iron workshops have been found or any other indicators it was a widely used metal. In fact, there appears to be no deep integration of ironwork into ancient Egyptian society that could compare to the likes of some other metals like copper, bronze or gold.

Middle Kingdom to Twenty-Fifth Dynasty

The earliest piece of iron from the next phase also appears to be meteoric. An 11th Dynasty (c. 2080-1940 BCE) *Pesesh-Kef* amulet from Deir el Bahari comprised of a silver head and iron blade was demonstrated to have the telltale characteristic high nickel content indicating celestial origins, at ten per cent. From the 17th Dynasty (?-1540 BCE), a piece of a chisel and part of a ferrule of a hoe handle was found at the pyramid of Mohammerieh near Esna. An elongated iron triangular point with a long, thin tang believed to be either an arrow head or javelin was discovered in the palace of Amenhotep III at Thebes, dated to the Amarna period (latter half of the 18th Dynasty which extended from c. 1539-1292 BCE) [Lucas & Harris, 1989, pp. 238-239]. The most celebrated of the New Kingdom discoveries are the pieces of iron found in Tutankhamun's (r. ?-1324 BCE) late 18th Dynasty tomb that include a famous iron dagger found within the wrappings of the boy king's mummy. The iron blade itself is plain, but the gold handle is decorated with a geometrical zig zag motif that ends in a rock crystal pommel. The gold sheath has a lotus pattern on one side and on the other side a feather motif that ends in a long-eared jackal, likely Anubis placed there to protect the king on his journey to the afterlife (Zaki, 2008, p. 116).

Other iron pieces in the Tutankhamun cache are a miniature headrest (Carter no. 256.4.v at the Griffith Institute), an amuletic eye within a gold bracelet (Carter no. 256hh[2] at the Griffith Institute), and sixteen blades that appear to have been produced for the "Opening of the Mouth" ceremony (Carter nos. 316a-p at the Griffith Institute) [Snodgrass, 2006, p. 130]. At least some of these objects may have been manufactured by Egyptians but if so how were they producing them?

An interesting study does provide a fascinating window onto this subject. Helmi and Kamal studied Tutankhamun's dagger by X-ray fluorescence analysis and found that it was terrestrial iron (93.3% Fe) and not meteoric. It had little nickel (2.8%) with trace amounts of chromium, aluminum, silver and copper. The decoration on the handle was almost pure gold (96%) and as expected the pommel was silicon, probably quartz (1995, pp. 278-289).

This largely ends some speculation on the subject.[23] As late as 1999, even after Helmi and Kamal's study was published, Waldbaum included the iron from Tutankhamun's tomb among her list of early iron pieces "deemed to be of meteoric origin" such as those at Gerzeh that have recently been proved to be meteoric, although she remained unsure because early examples of low nickel content iron had been found from the Bronze Age (1999, p. 30). Without any evidence for iron workshops , smelting areas or the like it is very difficult to determine how (evidently) smelted iron was

[23] We should always remember, however, that low nickel content *can* be found in meteoric iron so this alone does not provide 100% assurance.

showing up, albeit in small quantities, in Egypt in contexts from the Old Kingdom (c. 2543-2120 BCE) through the New Kingdom (c. 1539-1077 BCE). Trade, gift-giving along the Bronze Age circuit of Great Kings and indigenous Egyptian craftsmanship are all possibilities. I see these few specimens as examples that the Egyptians could have been keeping abreast of metallurgical advances in iron. Even if that is true, however, the main point remains that there is currently no evidence showing they were employing smelted iron or any iron in large quantities at this time.

Belzoni discovered an iron sickle underneath the sphinx of Horemheb (r. 1319-1292) at Karnak also believed to belong to the late 18th Dynasty (c. 1539-1292 BCE). After this time Lucas & Harris pronounce "there is a gradual increase in the number of objects of iron found, until the Twenty-Fifth Dynasty [722-655 BCE], of which date there is a group of iron tools, after which iron becomes much more common" (p. 239). Since the authors do not quantify this gradual increase I do so in the last part of this section in the analysis of the museum collections graphically and numerically as well as the appendix which I believe helps us understand the chronology of the Iron Age of ancient Egypt more accurately. At present, let us examine this group of iron tools for it comes from a cache that is entirely unique.

Twenty-Fifth Dynasty Cache of a Bronze Assyrian Helmet, Missing Trumpet, Bowl and Iron Tools from Thebes: Dated to the 7th Century BCE

At a brick chamber at the Temple of Tausert in Thebes, Sir W.M. Flinders Petrie's crew found a group of iron tools (Petrie, 1897, pp. 18-19 and Plate XX I). What made them extraordinary was the fact that they were not tools commonly found in Egypt and some of the other objects with which they were grouped were also either clearly foreign or rare. A bronze helmet shaped in a conical style that is seen among no known Egyptian examples was one of the key objects for its diagnostic value (see Appendix B, Figure 2 for the helmet, a bronze bowl and all the iron tools). The style of the helmet is commonly found in Assyrian art which convinced Petrie that it came from the Assyrian invasion and occupation of Egypt by Esarhaddon between 672 and 670 BCE. An accompanying bronze bowl was rather commonplace in form and told him nothing more.

In addition, a trumpet inscribed with the words "Asar-hapi gives life to Pekh-ar-khonsu, son of Du-amen-neb-nest-taui, son of Hor" which Petrie dated to the end of the Twenty-Fifth Dynasty (c. 722-655 BCE) during the reign of Psamtik I (r. 664-610) was found and then stolen by the workman who discovered it. Had this item survived it would have been of great historical value. As for the iron tools themselves, they included a sickle, chisels, file, rasp, crank, center-bits, scoop cutter and saws which were all of the Near Eastern types. For instance, the saws had teeth that did not alternate so they could only cut when being pulled towards the body and the center-bits were similar to ones that were actually being used by Algerians in the early 1900s. Therefore, these particular iron tools were believed to be an Assyrian introduction by Petrie (Petrie; Spiegelberg, 1897, pp. 18-19 and Plate XXI).

The idea that the Assyrians introduced smelted ironwork to Egypt and the methods for production, therefore, is a distinct possibility. Nonetheless, there are other possibilities; perhaps Greek mercenaries who lived in the Delta were responsible. We will consider this evidence shortly. Either way, note that the highly significant transition to smelting iron appears to be a possible foreign introduction. In our final section we will see that our best attested iron producers were certainly Greek influenced and we will see that the two earliest sites with probable smelting facilities are Greek enclaves as well. In all these cases we are led to the likelihood that iron was a metal with associations with the world outside indigenous Egypt which I believe helps us understand how they viewed the metal—even if it was not a completely foreign product it had quite strong foreign associations.

Let us proceed now to examine the evidence from the two Delta sites which also come from the earliest known time period when iron first becomes plentiful at some locations. This would be Snodgrass's Stage 2 seen at two highly significant sites.

6TH Century BCE

The earliest evidence for iron smelting in Egypt dates to the 6th century BCE. Iron slag heaps were found in the late 1800's in the Delta towns of Naukratis and Tell Defenneh by Sir Flinders Petrie (Johnson et al., 2013, p. 997). The first of these, Naukratis, had long since disappeared but its existence was well known to the world from the ancient Greek literary sources, particularly Herodotus who claimed that the pharaoh Amasis (r. 570-526 BCE) gave the Greeks the site as a commercial center after which it became the only Greek port in all of Egypt and the only place where one could acquire Greek goods legally[24] (Coulson & Leonard, 1982, p. 361).

Herodotus provides some details that I believe will become increasingly important in the study of ancient Egyptian iron. He says that twelve founding cities including six

[24] A "sister port" called Heracleion has since been discovered which we will discuss briefly near the end of this section.

Ionian poleis, four Dorian poleis, Aiolians from a polis on Lesbos and the people of Aigina built the site that included a settlement, trading post and sanctuaries in which to worship (Villing, "Naukratis: a city and trading port in Egypt," n.d., para. 1-2). One area where modern researchers believe Herodotus was incorrect is in the details surrounding the founding of the city, since Early Corinthian pottery from the end of the seventh century BCE was discovered at Naukratis belonging to the reign of Psamtik I (r. 664-610 BCE), a ruler known to have used Greek mercenaries. Therefore, a possibility is that Amasis gave the Greeks a charter to settle there permanently creating a major port out of a minor trading post that had already been in existence (Coulson & Leonard, 1982, pp. 361-362).

The history of archaeological investigation of the site has provided very significant information about iron production but also caused a few lasting questions because of the early sources and methods used by the principal investigators as well as the vestiges of time and local farming activity. In 1884 Petrie discovered Naukratis when he was still only a thirty year old, self-taught archaeologist with a keen interest in measurement and surveying but little formal training. By the time he reached the site – which consisted of a series of mounds covered with pottery sherds— approximately one third of the 950 X 590 meter area had already been destroyed by the *sebbakhin.* These *sebbakhin* are individuals who dig for material such as decayed papyri, limestone burned for lime and other refuse because they produce high phosphate soil useful for farming their fields (Coulson & Leonard, 1982, p. 362; Villing, "Naukratis: a city and trading port in Egypt," n.d.). Therefore, the site's attractiveness to locals is part of the reason behind its ongoing destruction.

Therefore, Petrie's first observations are key to us. They are actually a major reason that Snodgrass's tripartite scheme has any utility whatsoever and they have shaped nearly every single discussion of early iron production in Egypt since. What he recorded about iron is the following:

> A large and important class of objects are the iron tools found so frequently at Naukratis. They are always described to me by the Arab finders as coming from the lower strata of the town; and in two or three cases, where the exact level could be measured, I found it to be 320 and 330; this would correspond to the sixth century B.C. as the scarab stratum of 580 B.C. is about 330 level; and the find of Athenian coins, about 460 B.C. (which was close to the iron tools) is 370 level. [Petrie et al., 1886, p. 39]

In addition Petrie found iron slag, which in conjunction with the tools made a great impression on him. The following conclusions are some of the most deeply held about Egyptian iron to this day:

> What renders these iron tools of great interest is the large quantity of iron-slag found in the old strata of Naukratis, and the occasion [sic] pieces of specular iron-ore: these prove that iron was actually smelted and manufactured on the spot, and that this was a great centre of iron trade, if not indeed the principal source of manufactured iron to the Greeks of the sixth century. [Petrie et al., 1886, p. 39]

Disregarding Petrie's seemingly improbable argument about Naukratis' importance to the Greeks since ancient texts made it clear they had other sources for iron ore (Strabo *Geography* 10.3.22 and 14.2.7), Naukratis' position in the historiography of Egyptian iron has been long and storied. Notice that the iron he recorded discovering was entirely of the "useful" or "practical" variety in Snodgrass's parlance including many weapons and tools: 28 chisels, two celts, an axe, two hoes, six knives, two sickles, eight borers, a gouge, a double-handled pick, a scraper, six bodkins, four arrow heads, a poker, a large pig of iron that he believed was wrought for sale in bulk, later fish-hooks (probably Ptolemaic), an iron wall hook, Ptolemaic and Roman nails and two Roman keys (Petrie et al., 1886, p. 39, see Appendix B, figure 3).

One "Mound of Iron" May Mark an Industrial Sector

There is some increasingly important, revealing and somewhat surprising information that gives us great insights into the nature of iron production currently emerging from this site. Did iron production take place in people's homes? Was it associated with any of the religious structures at the site? Or was it an activity that was separate and isolated from the residential areas? We have no definitive answers for earlier periods, yet we *can* provide some answers for this era. New information combined with older excavations are beginning to answer these questions that clearly have implications as to how ironwork was viewed by its users.

The excavations at Naukratis were carried out by Petrie from 1884-1885, Gardner in 1886 and Hogarth in 1899 and 1903. Hogarth had found the site was continuing to be altered by the *sebbakhin* as well as flooding. Seventy years later Leonard and Coulson found more flooding and even entire features that had largely disappeared. Therefore, one strategy to uncover answers to our questions and many others has been to excavate new sections.

Petrie observed that a low mound, 50 X 75 meters, called the Kom Hadid, or "Mound of Iron" by locals, contained slag heaps in association with frescoed Roman brickwork. Petrie was notably not unduly influenced by the feature's very suggestive name. He believed the slag was the last state of limestone with which the Romans had built their large houses as he had found that whenever there was slag on an Egyptian mound a great limestone building had once existed there (Petrie, 1886, p. 10). The mound was no longer apparent during a survey conducted in 1980. Closer investigation and then subsequent work revealed the mound was merely waste from a Roman kiln (Coulson & Leonard, 1982, p. 364). It was not a home at all, and this is an important point given subsequent discoveries. Leonard ultimately gave this "Mound of Iron" a new identification: a "ceramic trash heap" (Thomas & Villing, 2013, p. 83). Surprisingly, this new identification made the Kom Hadid part of a much larger, more important discovery that helps us to clarify the nature of ironwork in Egypt at this time.

Conclusions: An Ancient Industrial Park

In 2012 the British Museum's researchers who conducted a short, new eight day fieldwork program that sought to reinterpret and integrate all 130 years of research and excavation at Naukratis into their own findings concluded that *the Kom Hadid was part of a larger eastern sector of widespread yet confined industrial activity.* Petrie had found a multitude of workshops for iron, silver and copper in this area. He also found a workshop for terracotta figurines from the Ptolemaic era (332-30 BCE) in an area where Hogarth later found many Tanagra-style and phallic terracotta figurines and molds. The British Museum team found even more. They undertook magnetometry as well which revealed something quite interesting, a rectangular structure of "cells" that the researchers believed probably represented warehouses or magazines. Altogether, the entire area stretching from the Kom Hadid to a modern village called Gebril Abbas— the greater part of the eastern section of Naukratis— appears to have been an industrial center for iron production among many other crafts that apparently quite purposefully excluded all but a few residences. [Thomas & Villing, 2013, pp. 93, 96 and figure 15]

Consequently, at present we can say that Naukratis' evidence indicates that this new, more functional, practical, one might even suggest "industrial" (in ancient terms) iron production took place separate from most domestic and religious structures in a larger area with similar activities like an ancient "Industrial Park." It would be premature to say that this is when the true iron-worker began to exist in Egypt, but it is a distinct possibility that this was an origin point for such a profession. Perhaps as numerous scholars suggest there were mercenary/iron-workers in significant numbers for the first time (Arkell, 1966, p. 451, Villing, "Naukratis: a city and trading port in Egypt," footnote 1 & Wilson, 2010, p. 252). [25] It does appear that the nature of ironwork had a different character than it did in earlier periods since there was so much more of it and it demanded a great deal of physical strength and obvious expertise to produce the objects. Again, it is a significant point that it would appear that this new industrial form of production appears in association with a probable Greek colony pointing to some of the significant turning points in iron production having the mark of foreign influence.

Tell Defenneh (Daphnae)

Tell Defenneh (Tall al-Dafana) was discovered by Petrie in 1886 near Qantarah in the northeastern Delta. He identified the site with Daphnai (Daphnae) and biblical

[25] Villing's footnote argues that the current evidence can be argued against the idea that the site was *originally* settled by mercenaries. Evidently the first evidence at the site predates their arrivals. Nonetheless, the probable dates of the mercenaries' arrivals do match the period when the first iron is believed to be used at the site so their role in introducing ironworking would remain an open question and possibility.

Tahpanhes (Petrie et al., 1888, p. 47; "Daphnae," n.d.). He located a fort founded by Psamtik I (r. 664-610 BCE). Greek pottery found at the site and Herodotus' descriptions convinced him that the fort had been a Greek garrison at their frontier peopled with mostly Karians (Carians) and Ionians (Petrie et al., 1888, p. 47; Petrie et al., 1888, pp. 48-49). Again, his findings entirely shaped the current state of knowledge about ironworking in ancient Egypt. His interpretation of the findings comports with Snodgrass's stage 3 in which iron production outpaces bronze, albeit in the same impressionistic manner of his description of the finds from Naukratis.

> Bronze objects were common in the camp, particularly arrow-heads of which many hundreds were collected […] Iron is as common as bronze, or rather commoner, and this shows well the relation to the metals in the early historic period to which these remains belong. The remains may be broadly divided into military and civil (p. 77). [See Appendix B, Figure 4 for the civil ironwork]

These two classes of "civil" and "military" iron do not break down with complete assurance, Petrie admits "knives" may have been used for civil purposes but includes some of them in the military section. He considers other examples of military iron to include horses' bits, lance-heads, a bident that may have been for fishing or the butt of a spear similar to bronze versions he found at Nebesheh, evidence of swords, possible ornaments for helmets although this is uncertain, spikes, iron arrow-heads which were found in great number—tanged rather than socketed like the bronze because they were wrought iron rather than cast like bronze— a swivel ring that he believed was for a chariot and scales that he believed belonged to armor (pp. 77-78). However, notice the ease with which we are able to incorporate both the "civil" and "military" iron into Snodgrass's scheme. All examples are utilitarian, practical forms of iron.

We know a lot of examples of iron were discarded in his investigation because Petrie says that when it came to “civil” ironwork he found chisels most often but only kept 40 examples while rejecting many others. Additional “civil” iron included two pickaxes unlike any found at Naukratis, a double-edged knife in perfect condition, other knives of various sizes, an auger or rymer with a cross-head handle, three pokers similar to the ones at Naukratis, five rasps or borers, an axe unlike that found at Naukratis, a trident that he believed to be used for fishing or as a spear-butt, and fishhooks exactly like the ones discovered at Naukratis. In addition, a block of iron 4 X 4 X 1 (he does not indicate what unit of measure) was also found at the bottom of a chamber (pp. 78-79).

What can be said of the conditions for ironworking at Tell el-Defenneh? There were a large number of iron scraps found in the camp which Petrie believed were a workman’s scrap heap. Once again, Petrie’s conclusions set the tone for how ironworking in Egypt would be viewed for 130 years.

> The amount of slag found all over the S.E. of the camp was astonishing; some was brought away, including a complete crucible bottom of slag mixed with charcoal. Some very fine haematite was found. It is evident that Defenneh was an important place for iron working, as Naukratis; and the light that these finds of arms, armour and tools of all kinds, throws on archaic Greek metallurgy and workmanship is of permanent value. [Petrie et al., 1888, p. 79]

Naukratis and Tell el-Defenneh’s Key Place in the Literature about Iron Production, Date during Which the Iron Age Began and the Question from Where Did the First Smelted Egyptian Iron Come? We cannot overstate the importance of Petrie’s excavations at these two sites or their influence on current impressions about ironworking in ancient Egypt, which I wish to argue should be seen as open to question and further study; a beginning point of analysis. From Petrie's discoveries until today, his evidence from Naukratis and Tell el-Defenneh have often been cited as the origin points of the Egyptian Iron Age, which we noted he dated to the sixth century BCE.

Arkell believed that much of the history of iron production could be determined from this evidence coupled with other discoveries:

> The first iron-working in Egypt was by Greek and Carian mercenaries, who were employed by the Saite kings set up by the Assyrians as tributary rulers of Egypt after the expulsion of the Cushites. These mercenaries worked imported ore at Naukratis and Daphnae in the Delta. In 591 B.C. a number of them were the spearhead of an expedition sent by the Saites to forestall a t[h]reatened reinvasion of Egypt by Cush, while the Saites themselves were embroiled on their eastern frontier with Babylon (which had replaced Assyria as the great power of the Euphrates). Even in defence of their homeland, the Cushites once again failed to stand up against troops armed with iron weapons, and Napata was sacked. The capital of Cush was now moved to Meroë above the Fifth Cataract. At Meroë there were both ample supplies of iron ore from the Nubian Sandstone and wood fuel and it is probable that the King of Cush started working iron there as soon as he could obtain the services of skilled craftsmen. [1966, p. 451]

We will revisit Arkell's theories in the larger story of iron across the wider region in the following section, but at present we might note that he believed iron was first worked in Egypt by Greek mercenaries and that the iron's origins were foreign as the ore was "imported." Furthermore, the general outline attributes the presence of Western Asians (Babylonians, in this case) and the Cushites (Kushites) in the south on the frontiers as reasons iron was necessary.

Researchers have argued vigorously and in many different ways about this evidence, but note how long some of the ideas have remained entrenched. As recently as 2010 we find a version of the story of iron that sounds similar and uses the original excavation reports of Petrie:

> Petrie identified iron-smelting facilities at Tell Defenneh, where aside from the finished tools and weapons there were also crucibles containing “iron” slag […] Civil and military ironwork was also found at Naukratis and Nebesheh […] as well as a horde of iron tools with an “Assyrian” bronze helmet at Thebes […] Iron working in Egypt is usually associated with East Greek craftsmen and the military because of the provenance of the find. Although there are known to be iron ore sources in the Bahariya and in the Western Desert, the material does not seem to have been mined in antiquity. [Wilson, 2010, p. 252]

Wilson goes on to argue that part of the Egyptian motivation to acquire Cyprus and parts of the Levant may have been their desire for wood as fuel (and ship building) as well as iron ore (Wilson, 2010, p. 252).

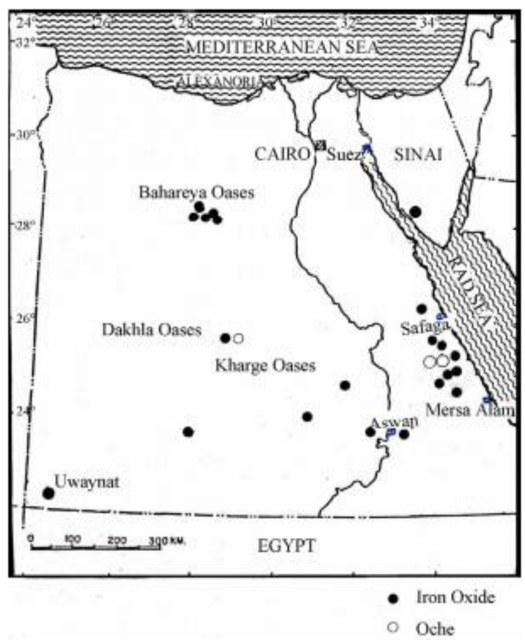
The origins of ancient Egyptian ironworking offer the backdrop to the last section when we will see Hellenized Egyptians were working in the area of Armant. I would insist that we cannot be sure of many of the main points that we wish could be on firmer ground. For instance, from where did the iron come? Was it imported as Arkell and Wilson argued forty-four years apart?

There is one literary reference that Alexandra Villing, the curator of the Department of Greek and Roman Antiquities for the British Museum, who lead the research project at Naukratis believes is quite telling as to what kinds of goods were being traded at the site that might also offer some insight into this matter. An Aramaic tax register from approximately 475 BCE during Persian rule records ships from one of the Greek cities that Herodotus mentioned founded Naukratis—Phaselis— arriving in Egypt with wine and oil while Phoenician ships, likely from Tell Ghazza, carried Sidonian wine, cedar, wood, Samian earth, building materials and metals including bronze, what appears to be tin and *iron* (Villing, “Naukratis: a city and trading port in Egypt,” n.d., section 1). The inclusion of iron in the ship’s registry confirms that at least some of the iron that was worked in Naukratis could have indeed had foreign origins, and not been mined in Egypt.

However, there is new information that further suggests we do not know anywhere near as much as we might have believed about ancient Egyptian mining. The authoritative entry on "Iron" by Ogden in the 2000 edition of *Ancient Egyptian Materials and Technology* makes a reference to Garland and Bannister's description of the "old workings at Wadi Abu Gerida" but argues that they are probably of Roman date (p. 166).

When we look at the actual evidence we should note that "very fine haematite [hematite]" was found at Tell el-Defenneh (Petrie et al., 1888, p. 79). A 2013 study by El-Rahman et al. examined the ancient mining and smelting features around Abu Gerida and found two different groups of shafts in the area. One was associated with copper, the other with hematite that was extracted from the site and transferred to a smelting station. Ptolemaic era (332-30 BCE) pottery fragments were also discovered in the area of the hematite which led the researchers to believe these shafts had actually been exploited during that time period, the Ptolemaic era, rather than beginning under Roman rule beginning c. 30 BCE (p. 1067). In fact, the researchers made an interesting observation: "among geologists it is common to assign any ancient settlements and excavated shafts in the Eastern Desert to gold mining. Such a practice may have led to an underestimation of ancient mining and smelting activities for ores other than gold from the Eastern Desert" (p. 1067). If this is true then the sources for the iron of Naukratis could have been indigenous to Egypt.

Scholars are skeptical that any iron was exploited except for pigments[26] in dynastic times prior to the Roman era (c. 30 BCE-395 CE) but the potential does exist. Iron ores including magnetite and hematite have been found in the Eastern Desert at a cluster of sites that include Wadi el-Dabba and numerous sites that share a common origin in the Western Desert including a number in the Bahariya oasis as well as in Aswan sandstone (see map 1 below; Ogden, 2000, p. 166; Abdel-Zaher & Abdel-Aziz, 2011, pp. 37-38).



Map 1. Location of Iron Mineral Deposits in Egypt (Abdel-Zaher & Abdel-Aziz, 2011, p. 38)

[26] The ancient Egyptians used minerals including iron oxides to create many of the colors in their artwork which is one of the reasons for the remarkable preservation in so many cases. The primary colors in tomb painting, for instance, were white, black, red, green, blue and yellow. Of these, red was almost exclusively the product of iron oxides found abundantly throughout Egypt (in the form of red iron oxide and red ochre, anhydrous and hydrated oxides of iron) [Hodel-Hoenes, 2000, p. 19].

Yellow was produced from yellow ochre, a hydrated oxide of iron that was also quite abundant. Brown was produced from ochre, an iron oxide that could be found in the Dakhle oasis. Mixing these colors could produce the appropriate colors as well. Orange came from painting red on yellow or mixing yellow and red ochre while brown could be produced by painting red onto black. The color blue was mostly produced from a frit based on silicates with low iron content called “Egyptian blue” (Hodel-Hoenes, 2000, p. 19).

Therefore, one can make opposing arguments for basic facts answering questions such as from where did the iron ore come? In addition, the astonishing discovery of ancient Heracleion (Thonis), the sister port to Naukratis has already provided 700 anchors, 64 ships—one of the greatest collections of ancient ships anywhere in the world— 16 foot statues, hundreds of smaller statues and gold and bronze proving commerce and metalwork were occurring on a grand scale in the area. The excavators believe work will continue at this new site for the next "200 years" suggesting we have much more to learn about the production of iron in the Delta and its relationship to the outside world since this new site will probably eventually offer some important evidence about iron too (Goddio, 2007; Goddio, Fabre, Clauss & Gerigk, 2008; Gray, "Heracleion," April 2013).

Nonetheless, the layout of the workshops at Naukratis, its separate areas for industrial activity and relative increase in the frequency of iron products do give us an important backdrop to understanding the nature of ironwork at this time. Ironworking appears to have become a much more organized and intensive affair, at least at some sites. Furthermore, some of these changes apparently occurred under foreign influence although we have to be careful to admit we cannot be sure that the iron ores were foreign and exactly when the iron from Egyptian mines began to be used. I do believe, however, that it is likely that it was during the Roman era (c. 30 BC-395 CE) that the mines were exploited to a much greater degree for reasons that will become clear throughout the remainder of this dissertation. There is evidence that the Romans had a much greater degree of interest in iron than the ancient Egyptians (to be explored in the final section) and we will see that the frequency of iron use shows a drastic change under their rule as well.

Some of the characteristics we have just seen come into view continue in the succeeding eras including Roman times (30 BCE-395 CE) which has an impact on how we will analyze the activities of the iron-workers in the final section. At present, let us become acquainted with some of the archaeological evidence from this era before we make note of how the museum collections demonstrate that the use of iron changed at this time.

Roman Occupation Example

At the site of Tell Yehud (also known as Gheyta or Rheyta) near the eastern Nile Delta, J. Garrow Duncan found a cemetery with significant evidence for Roman occupation. Numerous burials were discovered of soldiers whom Duncan believed to be Rhaetian merceneries (1906, pp. 54-55). In 1906 the excavator was clear that the use of iron had reached what Snodgrass would later refer to as stage 3: "The cemetery belongs to the period when bronze was more and more relegated to ornamental purposes, and iron was taking its place for the more useful and practical ends of life" (p. 58). In fact, most of the bronze objects that were discovered were jewelry, bracelets being the most frequent (p. 59). As I mentioned earlier, this site report may lack specifics but the fact that the excavator did describe the relative frequency of iron finds and how they were being used aids us because of Snodgrass's general scheme.

On the eastern edge of the cemetery most men who appeared to be Roman warriors were buried with heavy iron swords averaging two and a half feet long with wooden handles, wrapped in cloth. Iron buckles were found with such simple rings and pins that Duncan considered them to be "primitive" and un-Egyptian looking since the Egyptians were using a more advanced technology at this time. In addition, there was an oddity. Almost every warrior grave had an "abundance of [iron] nails" in "all shapes, some even with double cross-cut incisions on the head" (p. 59). Most of the nails had traces of wood adhering to them. Duncan could not determine their purpose. He did not find fragments of coffins so he supposed that the warriors may have been buried with wooden chests or boxes. In addition, iron locks were often found, which he also assumed belonged to these same wooden containers (p. 59).

Another observation of Duncan's comports with Snodgrass's conclusions throughout the Mediterranean. "There was one noticeable feature in their working of iron. They frequently used bronze along with it, and often bolted the iron pieces together with a bronze stud" (p. 59). By way of example he mentions a lock that had an inner side of bronze and an outer side of iron. As Snodrass had noted, a somewhat counterintuitive aspect of ironwork is it often appears alongside "a rich and varied technology of bronzeworking" (Snodgrass, 1980, p. 337). In all, Snodgrass's tripartite scheme and attendant observations continue to be useful for understanding the trajectory of the history of ironworking in ancient Egypt.

Currently the site of Amheida (ancient Trimithis) in the Dakhleh oasis, at the frontier of the Roman Empire, is producing about equal numbers of iron and bronze objects. So far they include surface finds, items found within a domestic context dated to the 4th century CE over the remains of a Roman bath, items from public buildings and others from a temple hill that date from the Predynastic through Roman times. Most of the iron they have found so far is quite corroded which does follow the patterns seen in the museum collections we will discuss next ("Amheida," 2016).[27]

Compiling the Evidence in a Database: When Did Egypt's Iron Age Begin and End?

Here is where we can make a true test of Snodgrass's scheme. Can we determine when Egypt entered the Iron Age? Can it also answer one of our key research questions? When did Egypt take the highly unusual step of *exiting* the Iron Age after having achieved it? Can this be quantified?

In 2014- 2015 I surveyed sixty-five museums across the globe which included all museums with substantial ancient Egyptian collections. This provided a list of fourteen museums with catalogues that included iron objects with the necessary dates, function and provenance in ancient Egypt (within the traditional boundaries north of Aswan) necessary to determine when Egypt's Iron Age occurred. Some museums had incomplete records but the data provided were employed whenever possible. The Brooklyn Museum and the University of Manchester's museum were kind enough to supply me with additional records to supplement their catalogues.

Each of the fourteen museums with iron objects fitting my criteria had between one and four hundred and thirty-five total objects for a grand total of approximately nine hundred and three objects altogether suitable for study. In some cases museum records

[27] Bruno Bazzani, Personal Communication, May 27, 2015.

grouped together indeterminate numbers of nails, lumps or other items so the exact number of objects had to be approximated as best as possible in these cases.

Although some museum collections contained objects up to the modern period, I only included objects from the very first appearances of iron in the Predynastic era (Naqada I) c. 3300 BCE to the Ottoman era (1517-1914 CE) since my primary interest was understanding the ancient use of iron. In spite of the fact that museum collections did include objects in the Islamic era (which began in 672 CE) and afterward it is apparent that they did so sporadically since such items would not necessarily be included in an *ancient* Egyptian collection. Therefore, I consider my results most likely to be accurate from the Predyanstic era c. 3300 BCE to the Coptic/Byzantine era (see appendix E for explanation of this culture/time period and all museum dates in upcoming charts). Any trendlines from the Islamic era forward are not likely to have any validity although I did include them so that one might see what the museums with ancient Egyptian collections' holdings contain for these time periods.

The objects that were in the ancient Egyptian collections included knives, rings, axes, adzes, fish hooks, bracelets, earrings, pendants, tweezers, amulets, fittings, hammers, dishes, pans and chains. Among the most plentiful objects were nails. The sites are found all across Egypt including Athribis, Asyut, Defenneh, the Fayum governate, Gurob, Lahun, Memphis, Naukratis, Oxyrhynchus, Qanadla, Qau, Tell el Yehudiyeh, Tell Defenneh, the Giza Pyramid, Shurafa, Tehneh, Wushym and the Ramesseum.

Once the objects were identified by function they were then separated into "decorative" (ornamental) versus "utilitarian" categories. Beginning with the Coptic era another category of what I termed "religious" items appeared. These were identified by obvious sacred imagery such as crosses. Magical items were considered utilitarian since the ancients believed they had efficacy. Prestige weapons were placed in the decorative category for reasons cited above, the chief being that Snodgrass considered them to *not* be indicative of an Iron Age. Dating varies by museum. For each museum I used their own dating systems for the initial tallies (see Appendix C table 5) and then grouped them together into more overarching (and sometimes slightly redundant) categories at the end which still maintained their differing systems (see Appendix C table 6).

Items were removed from the final tallies when their time period was not recorded. Objects that were "indeterminate" in function were excluded except for the first and last eras because these were highly significant objects. The first pieces of iron were of obvious import and the last object I included was a Mamluk sword that belonged to a guard. It was clear that iron was quite rare in both the first and last eras I recorded. In the earliest era it is obvious that this is because of the rarity of iron at this time. Excluding two indeterminate objects did reduce the number of ojbects for the tables below to approximately nine hundred and one iron objects.

What emerged were several interesting patterns. There are very few objects for all eras up to the Late Period (715-332 BCE) when 97 objects appeared and iron's function changed from its initial decorative use to a primarily utilitarian one. Then the numbers actually *fell* down to 40 pieces of iron. This is unexpected to say the least and the reasons why remain unclear to me at this time. For the Greco-Roman time period (332 BCE-395 CE) and “Hellenistic” or other similar designations an additional 23 pieces can be added around this rough era. The next finding, however, is by far the most significant.

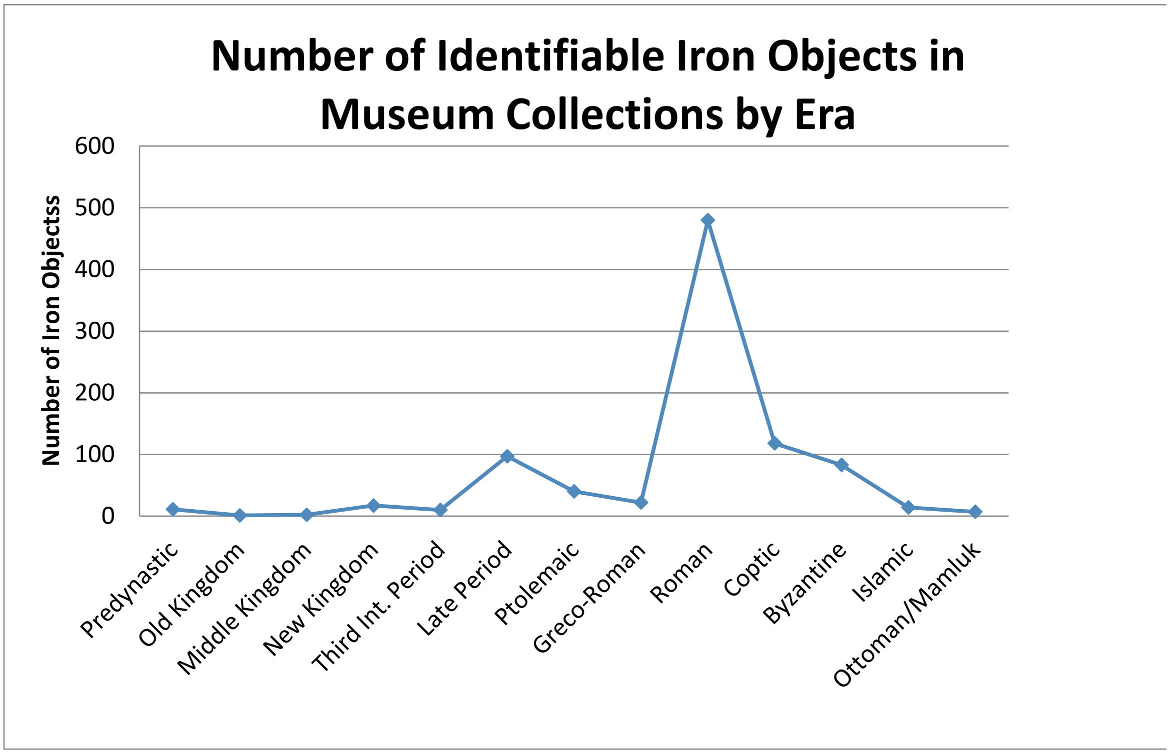
The true Iron Age appears to have come into full swing in the Roman era (30 BCE-395 CE) when a majority of the iron pieces coalesced at 476 total objects. Then there is another precipitous fall by the Coptic/Byzantine eras after which iron became quite rare once again. This data offeres a very representative picture of the patterns of use and the time periods for which they appear and can be seen in table 3 and graph 1 below.

Table 3. Patterns of Iron Use by Function and Era

Era/ No. of objects[28]	Functions		
Naqada 1 1	Unclear use		
Naqada II 3	100% Decorative		
Predynastic (Remainder) 7	86% Indeterminate	14% Decorative	
Old Kingdom 1	100% Utilitarian		
Middle Kingdom 2	50% Utilitarian	50% Decorative	
New Kingdom 17	100% Utilitarian		
Third Intermediate Period 10	90% Utilitarian	10% Decorative	
Late Period 97	96% Utilitarian	4% Decorative (4 objects)	
Ptolemaic 40	90% Utilitarian	10% Decorative	
Greco-Roman 22	82% Utilitarian	18% Decorative	
Roman 480	77% Utilitarian	23% Decorative	
Coptic 118	76% Utilitarian	24% Decorative	<1% Religious
Byzantine 83	64% Utilitarian	36% Decorative	
Islamic 13	92% Utilitarian	8% Religious	
Mamluk/Ottoman 7	86% Utilitarian	14% Decorative (1 object, ceremonial but possibly functional as well)	

[28] For calendar dates for these eras, see Appendix E.

Graph 1



What are we to make of the surprising discovery that Egypt enters *and* exits the fullness of its own peculiar Iron Age in the Roman era (c. 30 BC-395 CE), centuries after the 6th century BCE? Unfortunately, museums vary quite drastically as to whether or not they differentiate between Roman and Late Roman Age materials. One museum that was especially good about marking the difference between the two was the Petrie Museum.

The majority of their 435 piece datable and identifiable iron collection was Roman era at 278 objects of which 85% were utilitarian and 15% were decorative. The Late Roman era had only 47 objects of which only 17% were practical and 81% were for decorative purposes with 0.02% being unclear in their use. This is an astonishing

83.094% decrease. Moreover, there was a 69% decrease in the overall number of utilitarian goods produced between each era as well (see Appendix C tables 7-9). This remarkable shift back to largely decorative items at this time period would argue for a shift away from the industrial production of iron in Snodgrass's system.

As we recall, Snodgrass's idea of the Iron Age was predicated on whether or not iron use began to outpace bronze. I compared the bronze collections at each of the fourteen museums by choosing eight eras and then averaged the number of iron and bronze pieces at each museum for those time periods. In the Predynastic era beginning around 3300 BCE iron exceeded bronze but once bronze came into use it *never* did again. In fact, the number of bronze objects greatly increased in the Roman era (c. 30 BC-395 CE) and fell off in its appearance afterward much like iron! The following table 4 and graph 2 show this remarkable trend. Appendix C table 6 provides further detail delineated by each museum.

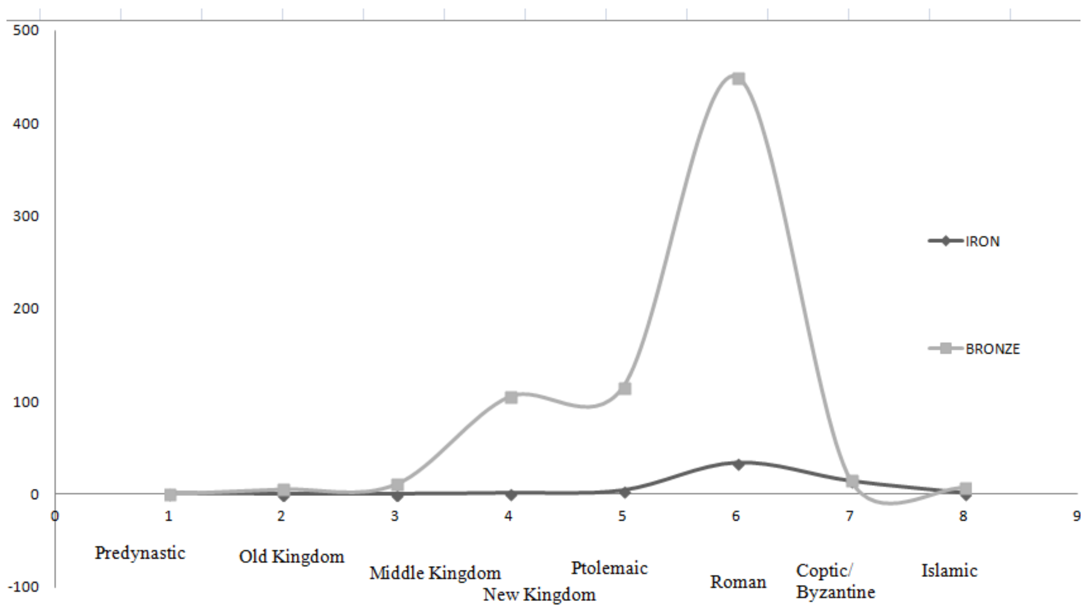
Table 4

Average Number of Pieces in each Museum by Metal

	IRON	BRONZE
Predynastic	0.78	0.64
Old Kingdom	0.07	6
Middle Kingdom	0.14	11.4
New Kingdom	1.07	105.7
Ptolemaic	4	116.07
Roman	34.7	450.29
Coptic/Byzantine	14.36	16.57
Islamic	1.14	7.29

(Iron exceeds bronze in the Predynastic and then bronze exceeds iron for all periods afterward.)

Graph 2. Bronze vs. Iron Use



(The peak of iron use is *greatly* exceeded by bronze; both rise and fall roughly around the same times with both peaking during the Roman era.)

This study compared the relative frequency of iron to bronze at those museums with both metals in accessible catalogues. Since additional museums have more bronze than iron this trend could only be exaggerated upon further examination of museum collections. If we are to offer possible explanations for these findings we can suggest the following: 1) since iron corrodes, less may have survived although we should note that the current findings at Amheida suggest one would often find some remnants, a point that Rhind made as well (more on this in the next section), 2) museums may be far less interested in iron than bronze due to the quality of preservation or any number of reasons, 3) excavators may have discarded more iron since we do know that Petrie mentioned doing so and we may be sure others like Duncan who excavated under his direction may have done the same, 4) excavations with a great number of metal items are prone to document the nicer specimens with greater frequency and a final explanation that we will explore in the greatest depth, Egypt may have had *no true Iron Age* in the sense where iron outpaces bronze and is preferred for utilitarian purposes.

I would reiterate that for the Islamic and Ottoman eras museums have different practices regarding where iron objects might be placed. Some objects were included with the ancient Egyptian material, yet these practices were inconsistent. What inspires confidence that the pre-Islamic trend lines represent real phenomena is the fact that the bronze collections peaked under Roman rule as well in spite of the fact that I amassed the data for iron and bronze separately. Coptic material is consistently included with ancient Egyptian collections and there was a rather substantial amount although, again, both iron and bronze from this era did display a reduction in appearance.

Therefore, I would argue that although the 6th century BCE may have been a significant turning point in the Egyptian use of iron complete with what appears to be an industrial sector largely reserved for production purposes, we need to add this important finding that iron use peaked in the Roman era (c. 30 BC-395 CE) at the same time bronze use was peaking (and exceeding the use of iron) as well. This modifies and begins to refine our understanding of ancient Egyptian iron use. How does the evidence explain these patterns of use? What was the difference between ancient Egyptian society during these varying time periods and what can account for the very odd fact that the ancient Egyptians reduce iron use in such a precipitous fashion? Furthermore, why was this ancient Egyptian Iron Age so subdued in comparison to areas of Africa, the Mediterranean and the ancient Near East?

In the next section, we look at the wider context of the study of iron across these regions and how it can contribute to our understanding of the reasons behind the changes of the use of the metal during three eras— the Predynastic, Late Bronze Age and Greco-Roman periods. In all cases we seek to describe the causes behind the changes (see Appendix B Figures 1-12 for pictures accompanying this historical overview and upcoming arguments).

Egypt and the Wider Region: A Literature Review to Discover an Appropriate Theory

Literature Review of Egypt and the Wider Region

The study of iron has proceeded at very different paces depending on the region. We see very different historiographies in the study of Egypt, sub-Saharan Africa, the ancient Near East and the Greek portion of the Eastern Mediterranean. Few works have undertaken the project of viewing these regions within their theoretical frameworks with a focus upon understanding how a thorough cross-comparison can demonstrate the following: 1) what can be known about the origins and spread of ironwork in the region and 2) what can be said about the nature of the social status of the iron producers and their relationship to their clientele? In answer to the second question we will be able to provide the theoretical backdrop to determine *why* people started to use iron in increasing numbers for utilitarian purposes at the beginning of the Iron Age. As interesting as it is to know that there was such a change in the use of metals it is an even more intriguing proposition to understand the underlying causes. In addition we may be able to see why the onset of the Iron Age varied so greatly from one part of the Eastern Mediterranean and Africa to another.

These projects impinge upon one another because once one looks at the cultural influences and the historiography very important findings emerge. The initial travels of early Greek and Roman (and to an important but lesser extent, Arab) writers have influenced the study of every one of the regions we will look at below. Their early observations often provide us with the only eye witness accounts of iron use in Eurasia, the Mediterranean and Africa. We will also see that very different sources and methods have been used to study iron in each of these areas. Africa outside the Nilotic region, from which some ancient methods of iron production survived well into the modern era, has the advantage of anthropological fieldwork. The Eastern Mediterranean abounds with early written sources concerning ironwork which are not as plentiful in Egypt, especially with respect to mythology and practical use, yet the archaeology of the region has had an enormous impact too.

Let us now delve into the some of the major theories, key works, overarching themes and substantive evidence for ironwork throughout Egypt, Meroë, Africa beyond the Nile and the Eastern Mediterranean. By the end of this section we will have an overview of some of the major movements of the technology across the region and what is known about how it occurred as well as some of the foremost theories. We will end with a theory explaining why some of the movements took place and what made Egypt's history of iron use so unique.

In the case of Egypt, we will look at one major debate and how the resolution of that debate can inform the present study of iron. We will see that when we look backward to the past there are some strategies for organizing the material evidence that led to the correct conclusion a century before most other researchers and before all of the intervening discoveries. It is my view that it suggests that the strategy we have employed in the previous section is fruitful.

Origins of Ironworking in Egypt and the Wider Region

Scholarship regarding the source for the origins of ironworking in Egypt and the wider region has a long and storied history. The earliest arguments from researchers writing in the late nineteenth and early twentieth centuries were greatly affected by the long-held belief that Egypt was the first civilization. Therefore, numerous scholars argued that Egypt was the source of many attributes of later cultures including ironworking (Trigger, 1969, pp. 28-29).

In the mid to late 1800s exactly how the Egyptians built all of their wondrous temples, pyramids, tombs and statues could not have been a greater mystery. Few stone tools had been discovered so that when a few pieces of flint, green basalt and other similar materials came to the attention of Sir Richard Owen, Captain Burton, Sir John Lubbock and General Pitt Rivers they were great finds. No known description of stone tool use was available from the Egyptians but there were helpful clues from the earliest Greek historians Herodotus and Diodorus who had mentioned that embalmers used stone implements. Consequently, researchers imagined that Egypt must have gone through a "stone age" but even this was admitted to be pure speculation and any further details such as the length of this age and how it was overtaken by metallurgical stages were completely unknown (Hilton Price 1885, 56-58).

General Pitt Rivers went so far as to presage the now well regarded practices of experimental archaeology when he took it upon himself to pick up some flint to carve a piece of sandstone at a temple in Qurna, proving to himself at least that the Egyptians *could* have carved hieroglyphs in stone with stone. However, his ideas were not the most widely accepted. There was much disagreement on the subject of when bronze and iron came into use. Sir Gardner Wilkinson believed that pictorial representations of tools that were painted with blue pigment represented iron and that it was the metal being used to create monuments from the earliest pharaonic times. His explanation for why so few iron tools survived would be one of the top reasons cited until well past the mid twentieth century when the situation remained the same: the nitrous oxides in the soil were thought to have decomposed all the examples (Hilton Price, 1885, p. 59).

The following discoveries confounded early scholars and ultimately inspired at least two different arguments: the discovery of the iron plate wedged in the Great Pyramid (in spite of the fact that there were no nearby iron mines or known workshops), the iron sickle found beneath a sphinx of Horemheb's (r. 1319-1292 BCE) New Kingdom monument by the circus strong man turned amateur Egyptologist, Belzoni, and the fact that stone and metal tools were found contemporaneously. There was also the possibility that linguistic evidence provided an archaic date for the use of the word *bἰꜣ* (initially transliterated Ba as we noted earlier) believed to refer to iron although understood to be a contentious issue in the late 1800s. In response, some either argued that 1) iron had been used at the very beginning of Egyptian history to produce the great monuments and carvings or 2) the tripartite stone-bronze-iron age scheme was out of order and erroneous. An example of both views is represented by Day's 1877 publication *The Prehistoric Use of Iron and Steel: with Observations on Certain Matters Ancillary Thereto* that marshaled enormous and detailed evidence to counter the increasingly popular idea that iron use was a late stage development whose widespread use post-dated bronze and stone. In fact, he proposed to turn the entire theory on its head, seeking to demonstrate that the earliest literary evidence was replete with references to iron and that the smattering of discoveries of early iron were indicative of frequent use. He proposed the following:

> [T]he very earliest period which modern research has yet reached back to on the Earth, is an age in which the human race is fully equipped in the knowledge and use of all serviceable materials simultaneously—not in any way progressive; that the earliest of all substances with which man was acquainted was unquestionably Iron, and almost certainly Steel—and that this is equally true, whether we look to Egypt, Babylonia, or Proto-Chaldea, and Assyria on the one hand, or China on the other (pp. 3-4).

Considering the contentious nature of the debate and the scantiness and patchiness of the archaeological, linguistic, and iconographic evidence it is not surprising that there should have been a lot of confusion about how to interpret the data. It is therefore even more remarkable that a few authors looked at the exact same evidence with astonishing prescience. We have already noted and will return to the insights of Wainwright that range from the brilliant and ahead of their time to the outlandish. At present I wish to turn to the work of A. Henry Rhind whose observations and argumentation about iron work in Egypt were surprising in their accuracy (in so far as we currently know) and were comprehensive in responding to the major theories of the day with the best possible answers. His approach was almost at the opposite scale of Wainwright's but no less plausible. They were, moreover, sober, systematic, analytical and cautious in a manner that would serve his conclusions astonishingly well. Rhind was a Scottish lawyer with considerable historical and scientific training who purchased the famous mathematical papyrus in the 1850s that is now held in the British Museum and bears his name.

In 1862 Rhind published a remarkable record of his excavations in the necropolis at Thebes during which the discovery of iron dated to the Late Period compelled him to devote an entire chapter to "the place occupied respectively by bronze and iron in the metallurgic economy of the ancient Egyptians" (vii). He began the chapter by outlining the oft-stated argument that the absence of early iron in Egypt was due to the decomposition of the substance. He found that his own discovery of 2,000 year old iron hasps and door nails were, however, "little, if at all, the worse for their lengthened service" (p. 218) making it likely that if earlier iron existed in great quantity it should have been able to at least survive. In his view this was a case where the absence of early Egyptian iron in all the museums across Europe was worthy of note and a highly significant fact (pp. 218 & 227).

Like the trained lawyer and one of Egyptology's first careful excavators he was, he then continued making his methodical case. Regarding the prevailing belief that objects of the color blue in pictorial evidence indicated iron he asserted there was "no such canon" of "universal application" (p. 219).

> For example, the fact has been cited that, in some of the early tombs around the pyramids of Geezeh [Giza], there is a well known group representing a man about to slaughter or cut up the carcase of an animal; and it has been pointed out that the man appears in the act of sharpening

> a red knife on a blue object similar in shape to modern *steel*, whose material, as prescribed by that name, the colour is held to indicate. (p. 220)

Rhind then noted that in another one of the very same Giza tombs, the exact same "steel" object in question was colored red while the knife was now blue (p. 220). He also noted that in the Twentieth Dynasty tomb of Ramses III a group of sword blades are alternately rendered in red and green and spear tips alternately appear in red and blue (p. 221). This was convincing evidence that implements represented in the color blue could *not* be considered incontrovertible evidence for early iron.

Again, Rhind was writing at the time when the meaning of *bỉꜣ,* then still transliterated *Ba*, was still being hotly debated. Nonetheless, even with severely handicapped information he noted that the amounts of this substance mentioned in the Annals of Thutmosis III were quite small. He believed that this would make sense if iron were rare in Egypt or little used at the time. He also cannily assumed that the iron's origins were Asiatic. He believed that region would probably soon be seen as a disseminator of the metal, which indeed became a later argument (p. 224).

Rhind addressed the piece of iron found in the joint of the Great Pyramid by Colonel Howard-Vyse and the sickle found in the New Kingdom sphinx by Belzoni and found the issues of their antiquity simply "too dubious to be conclusive" (p. 228). He then made an evaluative statement followed with a great overview of the evidence about utilitarian metals in Egypt:

> But in forming a judgment on this subject I would rather rely, not on the negative evidence of what the tombs may as yet have failed to offer, but on the more positive testimony deducible from what they have produced. […] [I]t is not easy to see from it [the evidence] that there was room, for the use of iron. Applied to nearly every *practical* purpose

it is bronze we are met with. [emphasis mine, pp. 229-230]

The practicality of bronze was no small observation and Rhind treated it at length, an early example of the arguments that have been carried forth to useful effect in the work of Snodgrass (as we too followed in the previous section) and Wheeler, for example, in the Mediterranean. Rhind proclaimed that when it came to "arms," "the variety preserved is certainly not great, nor the specimens numerous, but they are all bronze." (p. 230). The daggers were all bronze "fabricated with such skill as to rival steel in the elasticity which they retain to this hour" (p. 230). Axes and arrow tips (when not stone or reed) were bronze. His collection included a partial shield of bronze, needle with eye and a knife. At Thebes he was able to purchase a number of bronze tools including a saw, piercer and chisel. He found that the British Museum and all known collections had similar practical bronze objects, including even fish hooks (p. 230).

Rhind's work, as one would expect, was not without error. Even then, however, his reasoning was sound. He noted that the Italian Egyptologist Rosselini's objections that the Egyptians *must* have had iron tools to fashion monuments made from adamantine granite could be disposed of by the example of indigenous Mesoamericans, "the Mexicans," who he claimed worked emeralds with bronze. In fact that is unlikely. However, his further argument that the indigenous populations of Peru bored holes through emeralds with the leaves of plantains, sand and water on the observations of the geographer, chemist and traveler Bollaert further made his point and led him to the correct conclusion (p. 233). Iron was indeed *not* necessary for early civilizations to work stone.

Some of the primary methods of determining early iron's use on the basis of archaeological, linguistic, iconographic, experimental, historical, compositional analyses regarding nickel content and cross-comparative evidence were incipient by the mid 1800s and following decades. Today, early arguments continue to impact the study of the use of iron in ancient Egypt. Nonetheless, so many early analyses were led far afield from the correct conclusions that it is useful to see how success was met, partially so that it can be duplicated at present. I would argue that what led Rhind to such extensive prescience and accuracy (made more remarkable given his very short time excavating and brief life) is that he was devoted to systematic, organized archaeological and historical inquiry guided by close attentiveness to the actual evidence minus speculation. He turned to examples from other cultures like Mexico and Peru in order to offer possible explanations for the evidence he saw—stone work without apparent access to iron tools— rather than so many of his contemporaries who looked for iron expecting to find it because technologically advanced civilization as they knew it was dependant on iron. In addition, he paid special attention to the functions of the tools associated with each metal and was especially aware of the frequency of each metal's use. His underlying assumptions appear guided by the basic tripartite scheme that saw stone, bronze and iron use as part of successive stages. We may quibble with the stone-iron-bronze age sequence and rightly wish to point out that this is simply a useful overarching scheme with regard to Eurasia and of much less utility elsewhere but it does still retain some analytical advantages in organizing the material evidence with those caveats.

Later Petrie and his acolytes including Wainwright would apply similar principles to their excavations which were extremely significant, especially with regard to extending the knowledge of ironwork into the Predynastic and ultimately further into the Greco-Roman (332 BCE-395 CE) eras. These works are used in the important reference guides of Lucas & Harris and Ogden. Later, metallurgical researchers Snodgrass, Wheeler, Tylecote and others would be able to provide important contributions to the study of iron across Eurasia including significant observations about Egypt. Present studies such as the work conducted by Rehren et al., Johnson et al. and Latjar continue to benefit from these earlier works while making their own impact with many new observations and discoveries.

Africa. Over the last several centuries Africa has been plagued by difficulties including a period of intense colonialism experienced by almost every part of the continent, the following processes of de-colonization and the subsequent wars and internal strife. In spite of the vast range of the effects of all of this upheaval, African archaeology has recently become a widely recognized subject of inquiry with some institutional and financial support across the globe although many would certainly argue it is still not enough given the importance of this continent to world history.

The result of the recent interest, access and increasing understanding of African iron technology has had far-reaching ramifications. Some studies concerning Eastern Mediterranean and Levantine iron have turned to the African data to inform their conclusions and provide cross-cultural examinations (McNutt, 1990; Blakely, 2006). Ancient African ironworking technologies actually lasted into recent memory and can be demonstrated to have had a remarkably rich tapestry of symbolism, gender associations and a relationship to supernatural forces. We will see in the last section of this dissertation that iron-workers in Egypt were engaged in cult worship and that there are literary references that demonstrate iron could be associated with some kind of magical, healing properties. Nonetheless, it does not appear that there was a direct relationship between sub-Saharan ironwork and Greco-Roman (332 BCE-395 CE) Egyptian ironwork. I would also submit that some of the scholarship that has looked to African iron production as a source for universal symbols and gender associations has been misleading. In my view, there are, however, several areas where the African data is the most enlightening which began with the historical investigation of one group. The study of the link between migrations of people and the spread of iron technology as revealed by linguistic analysis has a significant time-depth in this area. This is centered on one people in particular: the Bantu.

In 2002 an important and relatively rare look at the social factors that affected iron production was published entitled "The Social Life of Iron: A Cross-Cultural Study of Technological, Symbolic, and Social Aspects of Iron" by Haaland, Haaland and Rijal. The authors reconstructed iron production in three societies, the Fur of Western Sudan, the Fipa of West Tanzania and two villages in Nepal. As an anthropological project it was an extremely useful enterprise for the authors that provided detailed descriptions of iron production and the associated symbolism and rites. In Darfur, Western Sudan, iron smelting had still been practiced until the 1950s so they were able to hire an informant to recreate rites that had not been performed for twenty years but were still part of their recent memories (p. 38). The authors utilized Randi Haaland's 1991 fieldwork concerning the Fipa and had a century of ethnographic reconstructions upon which to rely (p. 43). Their investigation of Nepal was based on studies conducted in two villages in 1995 and 1998. Based on works of cognitive anthropology, semiotics and Appadurai's argument that there is a "social life of things" (p. 36) the authors argued that any commonalities they found across these widely separated cultures were due to deep-seated cognitive and symbolic structures present throughout all of humanity. For their study the iron smelting process in particular emerged as one with enormous biological and gender associations. Furnaces were said to be female and iron-workers were primarily male. To them, this was a universal association, in other words, one we would expect to see in any culture, including Egypt.

> In many of the great civilizations, it is the destructive (not the productive) aspects that people generally associate with iron. The general impression is that iron tends to be associated with males, with strength (physical as well as mental) and dominance. Interestingly, iron objects predominantly are associated with evil forces. On this background it seems intriguing that iron smelting activities are generally metaphorically associated with sex and procreation, and the smelting furnace with females. [p. 35]

They also stated that their comparative ethnography "opened their eyes" to the fact that there was a "panhuman container schema" that among other associations, linked iron forging to pot cooking (p. 42). But did they find that? While the above associations did exist the specific details they cited opened up a world of examples of cultural variation as well.

Nepal is a country where Indo-Europeans and Tibeto-Burmese meet. The typical Nepalese furnace was made from red clay mixed with straw and water formed into a chimney-like shape approximately 120 cm high (p. 49). Sacrifices were a key part of the rituals and the majority of the authors' descriptions centered around this aspect of Nepalese iron metallurgy. The first day before a smelt a rooster was offered to the goddess of the forest and a hen to the god of the mines, the fusion of male and female blood was expected to help in the next day's smelt. The second offering was of a rooster provided to the "female" furnace and a third sacrifice was made to the smithy where the smithy and iron tools were sprinkled with blood (p. 50). The authors took this to demonstrate a clear male-female dichotomy to the rituals (p. 50). For the other two cultures they studied we do not see sacrifice as a part of the iron metallurgy. We also see additional details that are quite different from each other as well.

The Fur constitute one branch of the Nilo-Saharan language family who lived off millet and sorghum. Their blacksmiths produced shaft furnaces with slag-pits, four tuyères and sheep or goat skin for the bellows (p. 38). Women—in fact wives of the blacksmiths— took part in crushing blocks of ore into iron pieces before the smelting began but participated in no other activities (p. 39). Among this group the blacksmiths come from an endogamous group called the *mir*, who are highly stigmatized. One becomes a member of this kin group by birth and then the blacksmith skills are transmitted from father to son as the potter skills are transferred from mother to daughter. Other members of the community are prohibited from marrying them, dancing with them, eating with them or accepting food from them because they are considered unclean and untouchable—forming what was in essence a low caste (p. 41). Furthermore, blacksmiths are believed to be able to transform into other animals that are feared as similarly unclean and dangerous like hyenas, dogs and lions and thought to have the power to control thunder and lightning (p. 40).

This contrasts in a number of ways to the Bantu-speaking Fipa. The Fipa, the authors admit, had a much more technologically complex smelting technology that demanded more skills requiring a "master smelter" to produce a draft furnace with his son/assistant and some farmers followed by a second stage with fifteen to twenty villagers assisting (p. 43). They also represented their knowledge in a physical form: the master smelter's possession of a basket containing parts of animals, birds, fish, trees and two animal horns called an "intangala" was supposed to be the "soul" of the smelting process (p. 43). Furthermore, they had no ability to transform themselves into animals (p. 47). Another great divergence from the Fur is here the social category of the smith, the asiluungu, is an *honored* one. They can take daughters from other groups as their wives, had no restrictions against those of their descent group taking part in other professions, no connection between iron making and pottery making along gendered lines and the master smelter was, in fact, seen as the leader of the entire village (pp. 47-48)!

Why the differences? I would say that within the article they actually have a good argument for the case that the historical factors really need much more attention.

> We suggest that the special position of the blacksmith among Bantu groups originated with the expansion of Bantu-speaking people from Cameroon into the Congo rain forest. In the Sudan savanna belt the most important use of iron was as means of destruction, i.e., a use which affected the survival chances of competing states […]The consequences of this is well formulated by Maquet (1972: 83) 'This importance of iron is shown in the exceptional position given to blacksmiths in the societies of the forest clearings: master of fire, he is not only a specialized artisan, the only one in the village he also possesses magical powers for which he is feared and respected.' [p. 48]

While the “destructive” aspects of the use of iron capture their attention, I see this quite differently. I propose that we can show that iron was important to the Bantu for a wide variety of purposes early on in their history when they were all situated in their homeland in Cameroon. Many of the widespread associations that the authors of the above study consider to be “universal” including the link between iron forging and pot cooking are found among many African cultures because of the specific circumstance of the migrations of the Bantu (which we shall discuss below). One of the largest pre-modern migrations of people in all of history spread iron technology and the associated symbolic beliefs specific to their cultures including gender associations (we will see furnaces were seen to be pregnant wives giving birth to iron “sons”) and the relationship to pot cooking. The study of historical linguistics argues that there is evidence for iron production that can be recovered before the historical record as well.

In a similar vein, Aufrère has argued that the inherent difficulties of producing metal products at the forge made the blacksmith a “magician” in traditional societies (1997, p. 131). I believe we need to be more specific than this. Below we will find extremely varied viewpoints regarding the status of the blacksmith in societies whom we can examine ethnographically which means we need to be quite careful about attributing any generality to the way the iron-worker was viewed. It was not only quite different for each society, as we shall see, but the status of iron-workers might have easily varied depending on whom one asked and according to the specific time period as well.

For these reasons, a central argument I wish to make is that iron use in Egypt was a product of specific historical circumstances and that their own disinterest in iron and culture contacts with other groups who had integrated iron much more deeply into their societies often facilitated specific turning points including the increase in iron production in the 6th century BCE at certain sites like Tell Defenneh and Naukratis and the increase in iron production that took place in the Roman era (30 BCE-395 CE). At present, let us see how this compares to a culture that did deeply integrate iron into their worldview.

The Bantu. The spread of ironworking throughout sub-Saharan Africa has been attributed to the migrations of people speaking 400-700 closely related languages known as Bantu (Craig et al., 2011, p. 167; Shaw, Sinclair, Andah & Okpoko, 1993, p. 2). Bantu is currently believed to be a subgroup of the Niger-Congo language family, postulated to have originated as what is now known as Proto-Bantu sometime after 4,000 BCE in the area that borders the modern day countries of Cameroon and Nigeria in the western portion of Central Africa (Dunn & Mitchell, 2015, p. 105; Gregersen, 1977, p. 145; Guthrie, 1971, p. 7; McKay et al., 2013, p. 242). Current theorization about the Bantu often offers a very compelling and cohesive picture armed with great explanatory power that describes how iron-using populations were able to successfully absorb or supplant the hunting and gathering populations already living in the region. As we shall see, whether or not this widespread view is accurate remains a matter of some contention and debate. Nonetheless, the origins of the scholarship of the Bantu have a surprising time-depth.

The first accounts of the Bantu come from literate cultures that had an opportunity to observe details about the populations primarily along the coast of Africa although occasionally they were able to learn about peoples living a bit further inland. Sometime around 70 CE an unnamed, Greek-speaking Egyptian merchant from Alexandria described the area around the Red Sea, Persian Gulf and Indian Ocean collectively known to the Greeks as the "Erythrean Sea" in *The Periplus of the Erythrean Sea* (Scarre & Fagan, 1997, pp. 290-291). Here the author mentioned non-Bantu groups like the Berbers. He also describes tribes of "Fish-Eaters" who dwelled in coastal caves, briefly referred to "Wild Flesh-Eaters" and "Calf-Eaters" who were organized into tribes with their own chiefs and he names prominent cities that include the Nubian capital Meroë. In a land that may be Ethiopia, the author referred to a ruler whom he called Zoscales who traded goods all over the region including iron from India, but also iron that might have been indigenous such as that created by the Bantu. This iron was acquired in some form that enabled it to be fashioned by the ruler's people into spears for war-making and hunting animals that included elephants (Hoover, 1974).

At the tail end of the period of the Bantu migrations, Muslim mariners began to sail down the eastern coast of Africa at the same time that merchants were traveling across the Sahara via camel caravans. Many authors note this had the ultimate effect of connecting West and East Africa internally, introducing Africa to the extensive world of the Islamic caliphate which stretched from the Iberian peninsula of the Mediterranean to India, and thereby brought the world religion of Islam to many more areas of Africa

(Judge & Langdon, 2012: 274). It also brought some areas of Africa into the realm of the Arabic written record for the first time.

The "Herodotus of the Arabs," a prolific tenth century traveler named Al-Mas'-udi, described the "Land of Zanj" located within Southeast Africa. Here the people wore leopard skins, sharpened down their teeth, produced tortoise shell combs and ambergris for trade, raised cattle and were skilled in the use of iron. These same people practiced a religion that scholars described as "animistic." By the 1497-98 voyages of Vasco da Gama, there were two distinct groups in the same region. A hunting and gathering or pastoral population known as the Khoisan were living close to probable Bantu-speakers. The Bantu ate millet in porridge, used iron, and had straw houses. They lived in densely populated villages as well around the area of Delagoa Bay and were known to have used dugout canoes. [Hoover, 1974]

The true study of the Bantu people began in association with their languages; in fact, the first conflation of the people with their spoken languages began with the Portuguese missionaries and explorers who were then followed by other Europeans into the region. An early example was the Italian prefect to the Kingdom of Kongo, Giacinto Brusciotto, who compared the Bantu use of prefixes to those in Latin in 1659. The first appearance of the term "Bantu" in a comparative grammar by Wilhelm Bleek marked a significant moment as well. Bleek is known as the "Father of Bantu Philology" because in 1862 he alerted scholars to the fact that widely separated languages in sub-Saharan Africa appeared to belong to the same linguistic group (Hoover, 1974; "Wilhelm Bleek," n.d.).

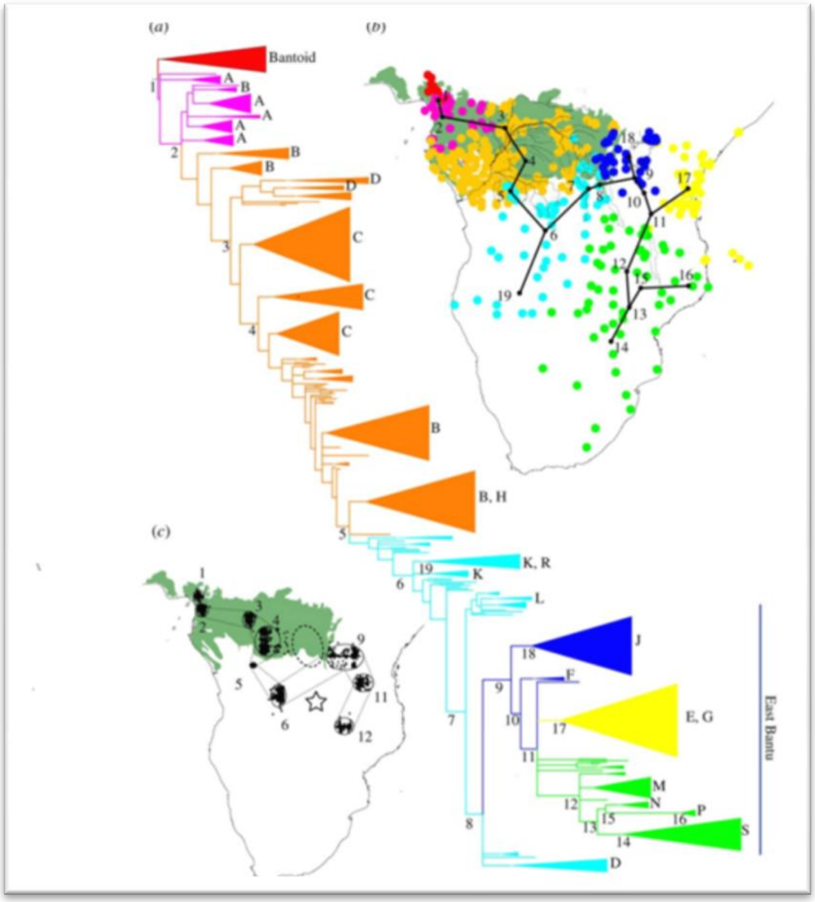
In Malcolm Guthrie's reconstruction of Bantu, which he termed Proto-Bantu X, he found convincing linguistic evidence for the knowledge of ironworking appeared quite early. Terms for "iron," *-gèdà and yèdà (numbers 800 and 1961 *ps. 500* in his index), "to forge," *-tùd- (1861 in index) "to blow bellows," *-dùgut- (number 737 in index) "hammer," *-yùndò (number 2171 in index) "to hit with a hammer" *-kòm- 1133 "axe" *-còkà- and *-tèmò (372 and 1706 in index) "knife" *-yèdé (1962 in index) and "wire" *-càmbò 268 were discovered.[29] Considering the nature and specificity of the terms, it would indicate that the Bantu had an iron smelting technology for making tools *before* they migrated outward from their homeland which would explain why ironwork became so widespread in the succeeding eras (Guthrie, 1971, pp. 11, 122, 126-27, 131, 140-41, 144).

The description offered in numerous books about Africa for researchers, scholars, popular audiences and university students alike derives from a combination of linguistic analysis that has sought to discover key words in "Proto-Bantu" which are then matched up as best as possible with archaeological data. Linguistic roots suggest that Bantu speakers built rectangular houses with palm thatch roofs, sculpted wood and believed in a supreme creator god that rarely involved him/herself in the lives of humans. This left room for a variety of other deities and ancestral spirits in the lives of the Bantu. For the overwhelming majority of authors what happened next was a part of a process in which Bantu farmers replaced foraging populations partially because they acquired the ability to produce iron, a great advantage over stone and wood technologies. In addition, the iron tools could be used for warfare. The grand narrative that authors use employs the

[29] Some diacritical marks could not be included because they could not be reproduced in this font.

evidence found by tracing an early language that became dispersed along a dual directional route.

Most authors set the first date for significant population movements around the second millennium B.C.E. The Bantu-speakers began to move 1) southward along the lower Congo basin to the southern part of the forest in the northern part of the province of Kataga in the modern day state of Congo and 2) eastward to the equatorial forests of the Great Lakes region of highland East Africa (see an example of a modern representation of the proposed possible routes from specialists in Map 2 below and examples provided for popular audiences and students in Maps 3 and 4 below. Also see map 5 in Appendix D for how these movements fit into the larger story of proposed routes for the spread of ironworking technology across the continent and region). Their boat technology (specifically, the dugout canoes) allowed them to travel via the rivers of the Congo basin first and finally to the Zambezi River in Zimbabwe. In the next phase the Bantu spread throughout every area of the lower one-third of the continent of Africa that supported farming. For the next one thousand years the Bantu proceeded by either absorbing and intermarrying with previous populations or pushing those populations further into less hospitable areas. For instance, the Khoi-Khoi and San were evidently forced into the Kalahari Desert. In the estimation of some authors this was one of the most successful, widespread and populous migrations in all of ancient history (see Craig et al., 2011: 167 & 170; Strayer, 2012: 35; Bentley & Ziegler, 2008: 484-485; Stearns, 2011: 192-193; Spodek, 2006: 113).



Map 2. Cultural Phylogeography of the Bantu Languages of Sub-Saharan Africa

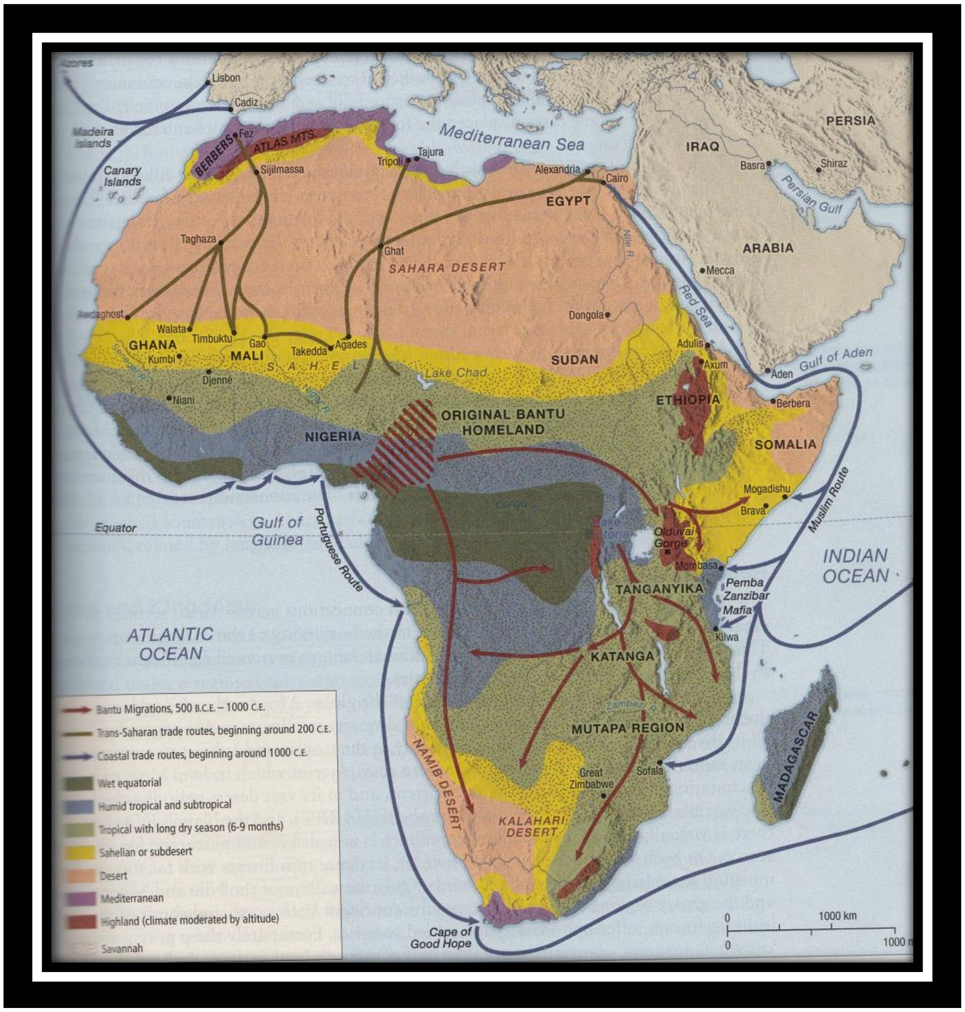
The Bantu homeland is widely agreed upon while the migratory routes as they expanded outward continue to be debated.

Some researchers still use approaches based on the work of Guthrie and other subsequent methods for linguistic analysis. Currie et al. built a phylogenetic tree of 542 Bantu languages (the triangles marked with lines, marked with the letter “a”) and mapped them onto the geography of Africa in order to test between several different Bantu migration scenarios. Their results support the argument that the Bantu homeland was around the Nigeria-Cameroon border. According to this study one migratory branch dispersed south and west, another moved towards the Great Lakes (Currie et al., 2013).

a) is considered to be a simplified phylogenetic tree with letters that correspond to “Guthrie zones” which are language groupings based on his work. b) is comprised of the ancestral locations of the numbered nodes which show the pathway by which the Bantu expanded.
c) corresponds to the distribution of some of the nodes including two alternate theories. The dashed-line ellipse refers to the location for dispersal hypothesized by Rexova et al. and the star refers to another scenario for the dispersal of languages as proposed by de Filippo et al. Currie et

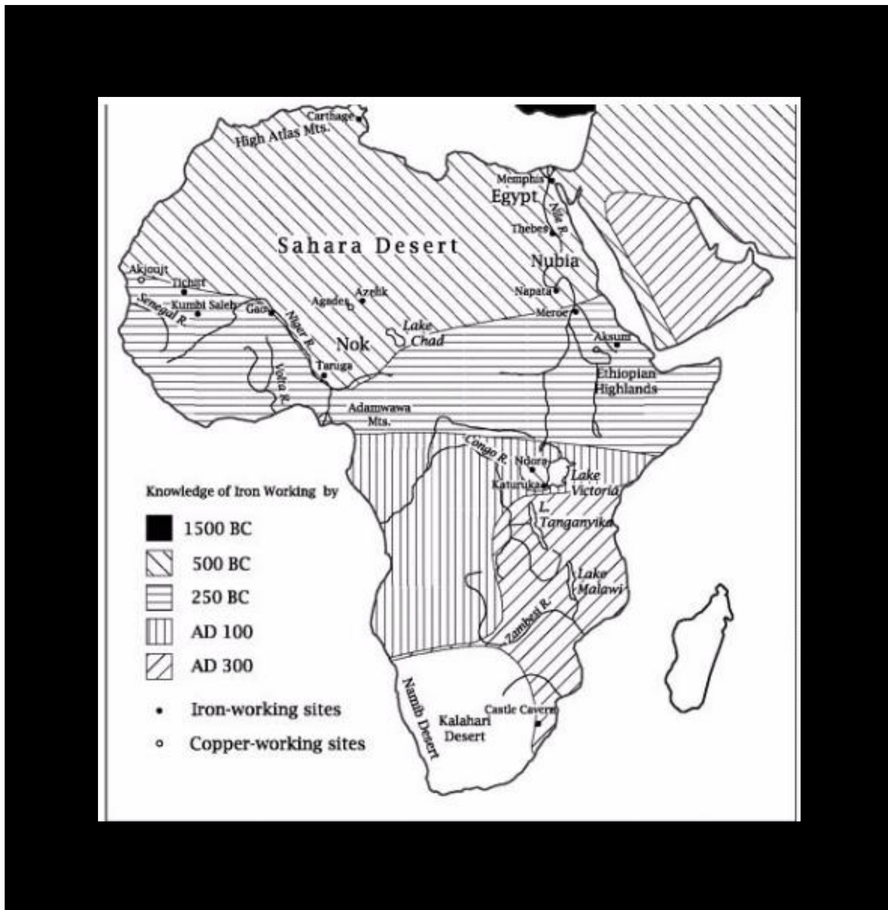
al. argue those two alternate theories were not supported by their work (Currie et al., 2013, figure 2).

Map 3 Example of University (or AP) Textbook Representation of Bantu Migrations (Judge & Langdon, 2012, p. 275)

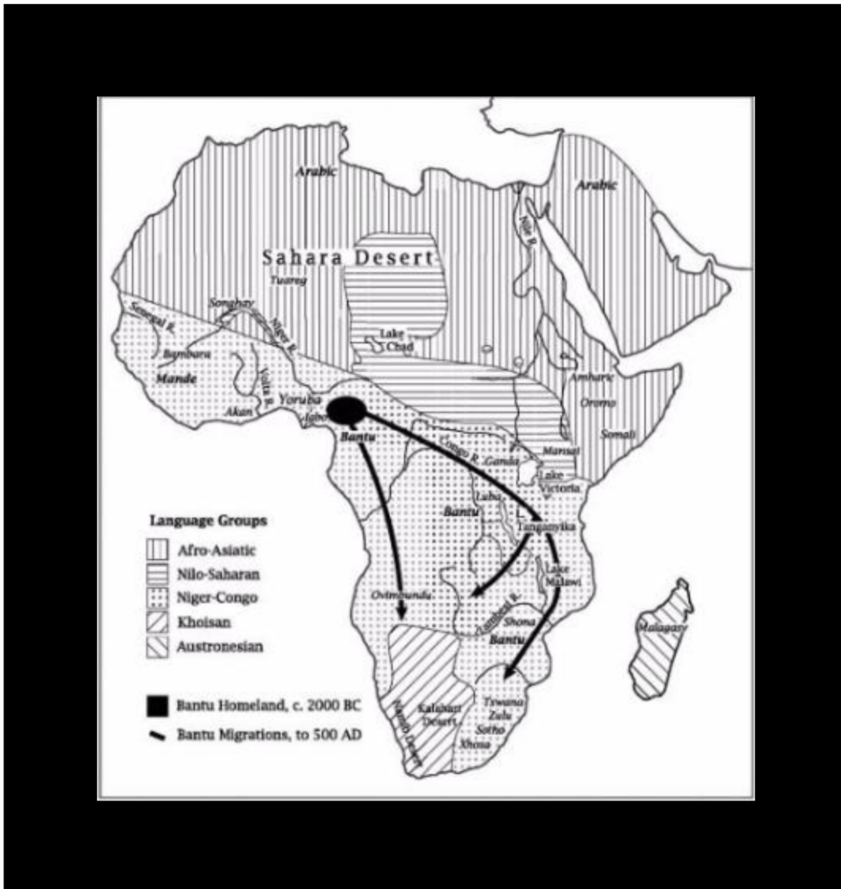


Maroon colored lines indicate proposed migration routes of Bantu between 500 BCE-1,000CE

Map 4 Iron and Copperworking Sites as Indicated by a Book for a Popular Audience Entitled "Key Events in African History : A Reference Guide" (Falola, 2002, p. 44)



Map 5 African Languages and Bantu Expansion (Falola, 2006, p. 48)



What we have established here is that ironwork in sub-Saharan Africa was a part of a significant migration and that linguistic evidence suggests that these were iron-producing people from the beginning of their expansion, regardless of which routes were taken to spread throughout the sub-continent. For these reasons, I believe that we already see a sharp contrast to ancient Egypt. Iron use was deeply ingrained in Bantu culture while they were still located in the original homeland, in the second millennium BCE, and evidence shows that even as their populations spread across ever-wider territories their iron technology remained deeply embedded into their lifeways which again appears to be a great contrast to Egypt.

But why were these iron-producing African farmers migrating? This is considered quite mysterious to most authors and the reason for their success is also difficult to ascertain. Not surprisingly, many believe that their metalwork was a very important factor here as well. The Bantu practiced a form of shifting agriculture. Some authors stress that iron enabled the Bantu to “conquer” hunter-gatherers although they concede that peaceful migrations or simple demographic growth may have also been important and the overall process was certainly “long, gradual and intermittent” (Stearns, 2011: 192). Other authors suggest the exact opposite, stressing that the Bantu were farmers (Reilly, 2012: 285) and that “they were apparently not military conquerors” instead considering their strong cohesion as a likely reason for their success because their villages were both political and social units. Equally likely, say these authors, is the possibility that the Bantu had a numerical advantage over the hunter-gatherers or brought infectious disease against which the hunter-gatherers had no immunity (Craig et al., 2011:170). Nonetheless, the role of iron is still seen as a key factor contributing to the success of the Bantu migrations even when agriculture is seen as the primary force behind their movements since they had many iron tools for that purpose. After 500 BCE most Bantu had iron all throughout sub-Saharan Africa which some authors note allowed them to produce iron adzes, axes and hoes permitting them to clear much more forest and take advantage of producing crops like bananas that they first domesticated or were introduced from Southeast Asia by the sea lanes (Bentley & Ziegler, 2008, p. 484).

The aforementioned arguments about the Bantu expansion already offer a great point of contrast to what we will see in Egypt. Thus far, there is no reliable theory that the origins of the Egyptian state or its territorial expansion at the height of its international influence in the New Kingdom (c. 1539-1077 BCE) were in any way reliant upon iron. Nonetheless, many would argue that the importance of iron is overstated with respect to the Bantu as well.

Opponents of this overwhelming majority opinion voice their critique on the basis of at least two problems. First, they see this sort of theorization as a part of a wider form of scholarship that consistently saw Africa as subject to outside, “civilizing” forces that often mirrored the European perception of their own colonization (Shaw et al., 1993: 10). The following lament is representative of this view:

> [T]he most extreme example of the stereotyped ‘bellicose’, superior armed race’ (i.e. Bantu speakers) [are featured] in many African archaeological books, whether for professional researchers or for secondary- and primary- school students. In many parts of sub-Saharan Africa, Bantu speakers supposedly introduced semi-permanent village life, metallurgy and agriculture (at least in the southern part of the continent), displacing the previous inhabitants. A great deal of archaeological effort—perhaps too much—has been spent on tracing the supposed routes of the Bantu expansion […] (Shaw et al. 1993:11).

So we see that some have thought that there has been too much attention to the role of iron in the Bantu expansion and others have seen the idea of them as a “conquering race” as a product of colonial attitudes. A second issue mentioned in the same quote is that too much archaeological effort has been devoted to looking for this Bantu expansion. We may add the problem of the assumption that all the groups they encountered were pre-agricultural societies. For these reasons and others new analytical models have emerged, some of which have impacted the study of iron. We will see below that they have revealed the ideas that moved with the Bantu populations as they swept across sub-Saharan Africa. I would argue that the sophistication of these new analytical models are extremely enlightening because they demonstrate just how ingrained iron production was into the fabric of Bantu society. Here we encounter ideas that have no direct analogues in ancient Egyptian society. This, I contend, is a significant reason why the technological advances and history of iron production proceeded so differently.

Gender analysis: symbols of reproduction seen in male smiths and female furnaces. The considerable time depth of the study of ironwork in Africa, the two-thousand year long history of ironwork itself which left behind a rich archaeological record, the many African societies that have been studied permitting cross-cultural comparison among Bantu societies, the great amount of oral histories and the fact that ironworking throughout most of Africa has an intriguing gendered aspect that crossects with its perceived magical efficacy has made it capable of the first significant gender analysis of iron production (Kent, 1998, pp. 158-159). Although gender studies came relatively late to sub-Saharan African prehistory, a case mirrored in Egyptology, the benefit to having this form of analysis arriving somewhat overdue is that the first full-fledged studies were able use all of the varied forms of evidence to great effect without being as reductionist as their few predecessors.

Early studies were missing the theoretical language and underpinnings with which to increase the understanding of gender in ironwork that was to come, but they did include very important observations that would lead to those later studies. As early as 1892 archaeological investigations like Bent's *The Ruined Cities of Mashonaland* noted that that there was a clear gender association regarding metalworking in Africa. The iron furnaces of Bantu language speakers such as the Karanga of southeastern Zibabwe were often decorated to look like highly emblematic versions of women. To European eyes these were seen as exceptional and extraordinary because of the overt and unmistakable representations of women. The furnaces were molded into shapes that included prominent breasts, genitals and female scarification patterns (figure 13 below). Recall that Haaland, Haaland and Rijal had believed furnaces were "generally metaphorically" associated with females. I do not believe we see this generally and would be surprised to find obvious associations such as these in Egypt.

Bent made his own associations. He witnessed the actual living females upon whom he believed the molds were based and noticed that tattoo decorations were located on their stomachs and occurred in lines up to thirty and forty in number which he believed were based on the furrows of a plowed field (Bent, 1892, 44-48). He found that the "breast and furrow" pattern was quite popular: "they admire it so much that they put it also on their drums, on their granaries, and on their pillows, and, as I have said on their forges." He believed it had a possible explanation and posited "I fancy it has to do with an occult idea of fertility" (pp. 47-48). I consider this culturally specific interpretation to be far closer to reality; culturally they associated women and their furnaces with what appear to be general ideas of fecundity. Considering the importance of iron in Bantu food production (not the case in Egypt to the same degree) this set of associations makes even more sense for their particular culture.

It was not until a century later that an actual gender analysis was produced that included these observations and wound them into larger patterns. Eugena Herbert's 1993 study *Iron, Gender and Power: Rituals of Transformation in African Societies* concentrated on the ethnographic evidence, reconstructions provoked by participant-observer anthropology and historical evidence from a dizzying array of Bantu examples. The resulting book described numerous variations and common themes in the production of iron work that then became a launching point for the author to look at how similar themes were found in other African rituals of chiefly investiture and hunting.

Herbert's thesis was that African rituals that were intended to create transformation used the metaphors of gender on one "horizontal axis" and the human life cycle on a second "vertical axis" which included re-uniting the living with their dead ancestors. She argued that together these two axes created a social sphere that had a powerful, creative force akin to human reproduction when applied to other endeavors like ironwork (p. 5). Ultimately, she believed gender is part of a host of other complementary dualisms: hot/cold, right/left, up/down, forest and village/savanna (p. 223).

Herbert referenced concepts and ideas that have a rich theoretical history but her work did not focus on in-depth discussions of her influences. "Power" was simply defined as the means by which certain, specific individuals attempt to gain control over their resources through the rituals of transformation (pp. 2-3). Her methodology was described as looking upon iron as a "multi-layered text" in which actors may rarely overtly know why they perform simple actions, therefore her job was to look for "fragments" of text across a multitude of examples to make a coherent description of the whole activity (p. 3).

For Herbert, gender is so fundamental a concept that it is a part of the "tacit" knowledge of a society. She contends that gender symbols and concepts are so obvious that they need no comment; it is only when they confront an "alien" view of society that they have to be translated into "belief." Although Herbert's direct citations for this particular theoretical underpinning to her work are Jean Camaroff, Mary Douglass and Dan Sperber, (p. 14) she does acknowledge a debt to Pierre Bourdieu (1977) in her bibliography. Bourdieu's very influential theories delineated in such works as *An Outline of a Theory of Practice* have a similar visual directionality to social space that can be seen in his diagrams and descriptions of society. Moreover, his concept of "doxa" defined as "the class of that which is taken for granted," and "the sum total of the theses tacitly posited on the hither side of all inquiry" is very close to Herbert's views. One only realizes that these unspoken beliefs exist when they come into contact with outside forces like a different culture. Then that tacit knowledge becomes negotiated through discourse and comes to be viewed as the "right" kind of opinion ("orthodoxy") or the opposing "heterodoxy."[30]

Herbert sees Mircea Eliade's *The Forge and the Crucible* (1962) as important for observing that metalworking was viewed along a procreative paradigm in many cultures but she ultimately harshly dismisses the work for narrowly overemphasizing sexuality,

[30] See the illustration of the world of tacit understanding or "doxa" that only becomes clear when it confronts the world of opinion ranging from heterodoxy to orthodoxy which are envisioned on a horizontal dimension from left to right (Bourdieu, 1977, p. 168).

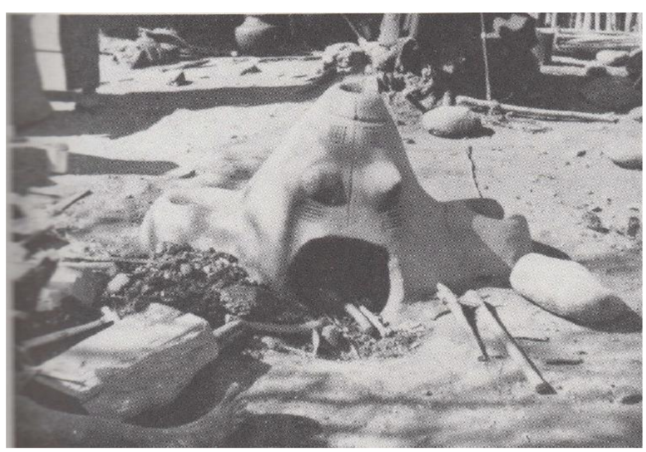
and for its gross simplifications of its subject matter. She also found that he failed to understand Africa from the specialist's point of view because of his world-historical analysis and the author's shallow understanding of the region. A final criticism she offered is that his work largely ignored the social aspects of metallurgy (p. 17). In her last point she references a problem that has beset Egyptology as well with some few but important exceptions.

Therefore, her work was new, bold and ultimately influential in looking at metallurgy across all of sub-Saharan Africa as a whole, for its view of metallurgy as a genderized process and for dealing with the genealogical aspects as well as viewing it as a part of overall transformative processes (p. 19). In fact, she mentions numerous Bantu societies throughout the book. What she found was there were key divisions of labor—first and foremost, the iron smiths and smelters were always male members of the same caste although many societies had traditions that claimed that once upon a time women had either incompetently or oppressively been in charge. For Herbert the fact that the furnace was anthropomorphized had a division of biological and culturally constructed symbols – the breasts placed on the furnace itself were a biological example while scarification patterns or beaded belts were an example of cultural symbols (p. 25). Furthermore, in spite of all the variation among smelting practices the male performing the smelt was universally required to abstain from sexual relations and menstruating women were excluded from the process altogether (p. 78).

Herbert benefited from being able to consult living informants who could explain many attributes of ironwork that would be hard to achieve otherwise. Informants widely agreed upon some of the symbolic representations of reproduction: the furnace represented a woman giving birth – or more precisely, the smelter's wife about to give birth to his son which explains *why* the women excluded from the smelting process were possible sexual partners who could compete with the furnace. In fact, prepubescent and postmenopausal *could* be included in the smelting process without fear (p. 95).

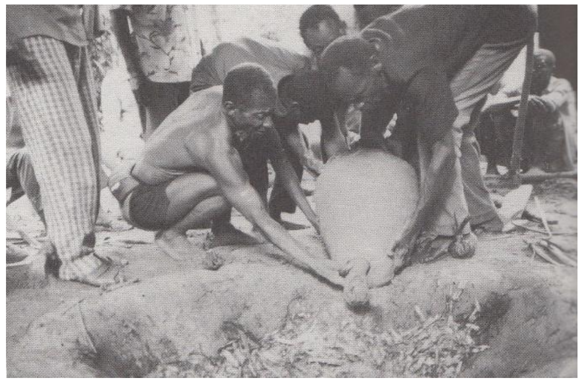
The block of iron thus represented the son of the female furnace and iron smelter and the slag was seen to symbolize the afterbirth in the form of placenta. The bellows and tuyères (clay pipes used to blast hot air) were representations of male sexual organs that "penetrated" the furnace (pp. 34-35) [see figures 13 and 14 below]. Among other key observations that are important because they would never survive archaeologically, she notes that music was at the core of the smelting ritual. Although one might surmise that the rhythm of the music could provide the accompaniment to difficult work, Herbert finds that the highly secretive and erotic nature of the songs suggests it was far more important than that (pp. 68-69).

Figure 13 Bantu (Shona) Furnace Reconstructed for Centenary Exhibition, 1953 (Herbert, 1993, figure 20)



Notice the prominent representation of female sexual symbolism.

Figure 14 The clay pipe called a "tuyère" (Herbert, 1993, figure 26)



Clear example of male sexual symbolism.

Susan Kent edited the first volume that looked specifically at and focused solely on gender in the archaeological record of Africa. It was appropriately titled *Gender in African Prehistory* and was published in 1998, a year that the editor lamented was a full two decades after gender studies had already become a common part of the social sciences (Kent, 1998, p. 9). The question of how to study gender in the archaeological record of iron technology was addressed by Peter Schmidt and Rachel McLean. Schmidt's chapter entitled "Reading Gender in the Ancient Technology of Africa" owed an obvious debt to Herbert. He relied on his own work among Barongo iron-workers of Tanzania but also looked heavily to Herbert's specific conclusions and observations cited above (pp. 140-141). A further debt to Herbert includes his methodology— he extended the idea of critically analyzing and comparing reproductive symbols in the historical and ethnographic context into the archaeological past for a similar "reading" of the evidence. He searched symbol systems for cultural and regional variability, variability over time (seeking the reasons behind these) and widespread, common symbols. Like Herbert, he was also convinced that reproductive symbols were seen as especially generative, powerful and creative.

We also see a similarity to other work about the Bantu in the work of Schmidt. Just as the historical study of the Bantu has relied heavily on linguistic reconstructions, Schmidt takes the work of historical linguist D.L. Schoenbrun (1993a) as an entry point for his own analysis. Schoenbrun argued that women had originally been in charge of the economic sphere because they dominated agricultural activities, but he found that at around 500 BCE their prominence was affected by the new economic impact of the male-dominated iron technology. Schmidt's argument was that one should be able to find evidence for Schoenbrun's proposed new gender roles by looking at changes in the symbolic systems of iron production over time. He believed that one should expect to see early signifiers that would be very robust, obvious and clear *male* symbols that would simultaneously demonstrate their newfound role in the economic domain around the time that iron technology was new and its meanings were still being negotiated. As time went on, he expected that those symbols would have become altered (p. 142).

To this end the author did find symbols that could be useful in gendered interpretations of archaeological evidence. The most significant example of "deep-time systems of meaning" he discovered came from his own 3rd and 4th Century Early Iron Age excavations of furnaces in the town of Moanda in southeastern Gabon. The "phallic" tuyères (again, the clay pipes for blasting hot air) were filled with the white clay called kaolin that Schmidt argues had a strong symbolic connection to male fertility as a representative of sperm and by extension, he argues, newfound male domination in the economic sphere (pp. 156-160). In Schmidt's "reading" of the evidence the more muted symbols that followed incorporated the feminine aspects of the reproductive cycle. He notes that this defies common interpretation, "A ritual cycle that embraced women is a significant departure from our conventional understanding of the reproductive paradigm—one that separates women, stigmatizes them as polluting and sterile, and excludes them from economic rewards that derive from the technology," (p. 151).

During the processes of iron production, the furnace came to be seen as a bride about to give birth to the iron bloom which required ritual action of the smith "father" that associated the furnace with reproductive organs, fluids and products: i.e. the bellows were seen as testicles, the blowpipes were viewed as phalluses and the slag was afterbirth (Schmidt, 1998, pp. 140-141). The next one thousand years saw the inclusion of other female symbols into the repertoire of ironwork, like "fertility pots" and fertility medicines that appeared at the bottom of furnaces. Schmidt was convinced that other authors like Herbert (above) and MacLean (below) were correct in seeing these pots as associated with females through cooking (p. 160). Thus, as expected he saw gender symbols negotiated through time and some of these symbols like the pots could be seen in the archaeological record suggesting that similar gender analysis would be possible.

MacLean's 1998 "Gendered Technologies and Gendered Activities in the Interlacustrine Early Iron Age" chapter from the same volume looks at the social changes associated with new technologies that appeared in the 1st millennium in the Great Lakes Region abutting Lake Victoria in the modern day countries of Uganda, Rwanda, Burundi, Tanzania and Kenya (p. 163). She notes that archaeological surveys conducted in the Rakai region of southwestern Uganda revealed aceramic bands of microlithic-using foragers who roamed the region, stopping in areas that had shallow soils but afforded them natural protection like rockshelters, upper slopes, ridgetops and hilltops near other bands of people who appear to be quite different from them. These other groups had roughshod pottery with fish designs and are known to us as the "Kansyore" (pp. 166-167).

In the middle of the 1st millennium BCE there were extremely significant changes, an iron-using people with high quality ceramics called Urewe ware appeared. In addition to introducing iron and ceramic production they can also be paired with the new practices of land clearance, agriculture and pot cooking. To MacLean two new activities they introduced had gender implications: iron production and pot cooking.[31] She considers this to be a complementary equivalence, i.e. "equally complex, equally powerful, and linked conceptually in a developing belief system" (p. 174). She shares the observation with Schmidt who noted that across many societies distributed throughout Bantu territories in eastern and southern Africa, iron was associated with males. Alternatively pot cooking was a female activity and she believes it was just as revolutionary to the society by bringing about new nutritious forms of food production

[31] In general the pots of the region are ceramic and made of fired clay, some of which can reach as high as a person standing up at mid-waist (or sitting down, reach nearly as high as the head). Others can include elaborate figurines (Herbert, 1993, figures 39-41). Herbert also explains that the connection between pots and iron are that both are products of the earth that are transformed by fire into important objects of daily use (p. 200). The Bantu pots also have an intriguing gendered aspect: "masculine" pots formed with necks are produced for cooking foods and "feminine" pots without necks are produced for holding water. In addition to other symbols like signs for earth and water (both of which are thought to be feminine) some of the same symbols found on female furnaces are located on the water pots too including the scarification pattern and a representation of a breast and navel (p. 210).

including the ability to heat treat foods through "wet" methods including steaming, boiling and fry cooking (p. 169). If this is correct, we can now see how the association between iron and pot cooking developed and expect that it was not "panhuman" or "universal" to all societies like Egypt, but instead, again, very much quite specific to this culture and then only became quite widespread upon the routes that we followed of the Bantu expansion.

MacLean differs from Schmidt by providing a biological reason for cooking to be more highly associated with women – nursing, she argues, might naturally prepare one for nourishing the family. In her assessment, the occasional cases of female iron-workers and their support roles demonstrate that iron production has no biological reason for being associated with males. She turns to Mircea Eliade's 1962 *The Forge and the Crucible* as a starting point for her alternative, cosmological (and essentially cultural) explanation for why iron production would become the purview of male smelters. She sees Eliade's argument that a general, common worldwide view of iron ore as a substance that develops in the "womb" of the Earth as the reason why the majority of societies in eastern and southern Africa saw smelting as a generative, procreative process. The Earth and then the furnace provide the biological origin point for the male smelting "father" to create an iron "bloom" (the first mixture of iron and slag created in iron production) that is later wrought because of the natural way in which many early peoples viewed the intrinsic, gendered nature of the ore itself (p. 170). In this way, she differs from Herbert who rejected Eliade's views. In another way she does follow Herbert for she sees gendered cosmological views of iron production as part of wider rites of transformation associated with reproduction. Nonetheless, she makes her own specific argument by noting that the means of cultural formation is achieved through the concrete, physical use of heat.

> In many eastern and southern African groups the linked processes of iron smelting and procreation are only two elements in a wider cosmological system of heat-mediated transformation; the third element is that of pot cooking […] These three processes represent the transformation of *natural products*, stone/ore, blood and semen, plants and animals, into *cultural products*, iron, a child, cooked food, and are linked through their fundamental nature of irreversibility and by the use of heat as a primary force in the effecting of the transformation. (p. 173)

Ethnographers working within Africa have continued to observe and record iron production which has led to an increased understanding of the diversity of the chain of operations among populations and the role of charcoal production and mining. In addition there has been much greater appreciation for the socio-cultural contexts of iron production including issues regarding symbol systems and magic (for example Haaland 1985; van der Merwe & Avery 1987; Reid & MacLean 1995; Childs 2000 in Iles, 2013, p. 268). This has served to elucidate the increasing archaeology in Africa in many interesting ways. An intriguing and insightful interpretation of how the technical aspects of iron production and ritual might serve to reinforce one another that builds upon this growing body of research comes from a study of the use of plants in iron production conducted by Louise Iles, published in 2013.

The work of ethnographers has revealed several roles for plants in the production of iron. Most importantly they were used in the form of charcoal for fuel. In addition they could be used in ritual or symbolic activities (which the author does not specify any further) or be incorporated into the structure of the furnace itself. There were also restrictions that limited access to sacred groves or specific plant species. The best sources that the author was able to locate of plant material left behind archaeologically came from the slag (p. 268).

The slag is a liquid byproduct of waste material from the iron production process formed of fayalite and other oxides that drip through the furnace (Fillery-Travis, n.d., para. 8). When this byproduct is collected in a pit at the base of the furnace it is called a "slag pit." A shallow pit is dug beneath the furnace shaft and packed with rigid plant materials including straw, twigs and heather that all become a receptacle for the molten slag. Fortuitously, this creates impressions of the plant remains in the slag itself. The second type of furnace structure is called a slag-tapping furnace which is where the molten slag is periodically drained away from the furnace and then deposited into a shallow pit (p. 269).[32]

The author took 500 casts of plant remains from slag blocks from the ancient Buganda kingdom that was located within the modern country of Uganda in the Great Lakes region of eastern Africa. Iron had played an important historical role in the kingdom. Early in the kingdom's history they absorbed two territories that were major iron producers, Kyagwe to the east and Masaka to the west. The new access to iron facilitated the harvest of their staple crop, bananas, and were used for weapons needed to maintain and augment their power which culminated between the 17th and 19th centuries (pp. 269-270).

[32] The author does not mention whether or not slag-tapping furnace pits are also lined with plant material, or if they are normally lined with different types of material. This later appears to be a significant point in the analysis.

Once the casts of the plant materials used in the production of iron were analyzed a pattern emerged—there were three distinct choices of plants that corresponded to the three main areas of Buganda. The data from Kinansi in the Kyagwe region showed that grasses were used 90% of the time and sedges 10% of the time, a finding that made sense in this grass/savannah/forest area. When Iles compared this to the metallurgical data she found that there was the same striking uniformity (pp. 270-271). The site of Masaaba in the Kyagwe region, 10 km from Kinansi produced 65% grass impressions in the slag, 3% Musacae leaf (banana family) and 20% dicotyledonous leaves (one of two groups into which flowering plants are divided) which confused the researchers until they discovered that the iron production method had been quite different. The slag had been tapped rather than formed in a furnace pit like the other sites (p. 271).

Another body of material came from Masaka which only produced six casts from one smelt, but still both grasses and sedges were identified. At Birinzi in the Masaka district 75% of the plants were sedges. Modern Birinzi has papyrus and swamps closer to the iron production centers than their grasslands making the outcome quite appropriate (pp. 271-272).

Altogether, the research showed that there were several different distinct iron production techniques within the kingdom of Buganda as a result of their territorial expansion, i.e., "the sociopolitical setting of the kingdom may have given rise to the existence of such diverse iron producing industries" (pp. 272-273). Secondly, the plants used were different due to the ecology of each area and a third intriguing suggestion comes from the author based on the work of de Barros (2000) regarding the surprising uniformity in her first results from Kinansi. "Because of iron's high material and cultural value, and the high cost of a failed smelt, many recent iron production technologies in the Great Lakes region have been seen to be steeped in ritual and tradition, which may serve to ensure technical repeatability and control over process" (p. 271). She notes that even the nontechnical features like sexual prohibition and the attribution of gender to the different ores were integral and repeated in the same way. She believes all of the smelters had a "variety of mechanisms in place that acted in keeping their materials and actions the same in every smelt they performed, in order to increase their probability of success" (p. 271).

Conclusions about the role of symbol systems, ritual and ideology in iron production. Consequently, from this enviable ability to reconstruct iron production and its associated sociology in sub-Saharan Africa in exquisite detail through plant remains and archaeological and linguistic analyses as well as the study of symbol systems a process unmatched by the records from Egypt we can say with great assurance that iron use was a part of the *deep structures* of Bantu culture. They were iron-producers by the second millennium BCE in their original homeland and by 500 BCE all of sub-Saharan Africa—a third of the continent— was producing iron as a result of their massive migratory movements. We do not know the origins of their iron technology nor are we sure of their relationship with the outside world. What we can demonstrate is that rather than "panhuman universals" we see very culture specific associations that tied the Bantu expressions of iron use to their entire understanding of biology and gender and much of their worldview itself.

When we look to the three time periods of ancient Egypt that we will study, there are no such examples of an equally complex symbol system or all encompassing worldview and accompanying lifeways related to iron production or use. Intriguingly, however, we do note that there are a few clues that some of these magico-religious symbologies have some analogues in Egypt.

In the few Old Kingdom (c. 2543-2120 BCE) references to iron we have cited we *do* see *some* biological examples of transformation beginning at that time since the king's body incorporates some iron morphology upon his apotheosis which is rather fascinating. Consequently, the ancient Egyptian had *some* demonstrable degree of commonality with other pre-modern iron-producing cultures, a point to which we shall return in the final section of this paper when we discuss the magico-religious beliefs the Greeks and Romans had about iron that the Egyptians shared to a certain degree. Therefore, it is quite important to note now and later return to the point that this etic archaeological method of viewing technological advances in ironwork in accordance with a procession from less practical to more practical aims does *not* match the emic, or ancients' view. We will see they had magico-religious beliefs about iron from our earliest records to the Roman era (c. 30 BCE-395 CE), and likely beyond that as well which might have even been transposed onto the landscape of early Christian thought with some Coptic iron goods.[33]

Nonetheless, the differences between the Bantu and the ancient Egyptians regarding their views toward iron are equally striking and probably even more important

[33] We will not treat the subject of the Coptic iron goods, but many surveyed in the museum collections do have obvious religious symbology that often had pre-Christian roots and predecessors.

for I believe they explain the different historical trajectories of iron use between these two great cultures. It is quite noteworthy that we do *not* see the same level of deep and sustained metaphors among the ancient Egyptians that encompassed so great a part of the worldview as the Bantu. It does appear that iron-workers in ancient Egypt were all male (the few names associated with iron-workers we have are all male as we will discuss in the final section) and there may have been some father-son transmission of the knowledge of ironwork but evidence for a full caste of iron-workers is *not* evident. We do not know of any gender markings related to any aspect of furnace technology and smelting or any special powers associated with metalworkers like the ability to transform into feared animals or control lightning.

Regarding the status of iron-workers we saw that their positions varied quite drastically by each culture so that there is no "traditional" single role to which we can assign them. In Egypt the most salient clue we have about their status comes from the *Satire of the Trades*, a Middle Kingdom (c. 1975-1640 BCE) work that is quite suspect since it was meant for scribal instruction for the apparent purpose of inciting children to work hard at their studies. Other professions are compared negatively with respect to the scribal trade. The metalworker is no different. The composer says one never sees a goldsmith on important business and the metalworker at the furnace has hands wrinkled like "crocodile skin" and smells worse than "scraps of fish" (In Scheel, 1989, pp. 59-60). Is this how certain segments of society would come to view iron-workers as well? It is paltry evidence but considering the absence to date of tomb biographies boasting of ironworking associations at the very least it appears unlikely they were village leaders or prominent members of society as one would find in some other African cultures.

It is not until the Greco-Roman era (332 BCE-395 CE) that we begin to see some examples of iron-workers taking part in cultic activity. It could have occurred earlier of course, but note that this is *exactly* the same time that iron production was at its greatest extent. At that point I will argue we see something we *cannot* locate at present for the Bantu: foreign influence and emulating foreign models of craft organization. The Bantu guilds appear indigenous, the Egyptian iron-workers' organization we will study is Greek (or possibly Roman) derived. It is my contention that foreign influence did alter the course of ancient Egyptian ironwork and even the very perception of iron itself, a point we will re-visit in the following sections.

Although we will explore historical reasons for the disruptions of iron production in ancient Egypt as well after the Roman era (c. 30 BCE-395 CE), I would argue we should be mindful that it is very likely that they were also simply more susceptible to these disruptions as well because ironwork was not as deeply ingrained into the culture, lifeways, worldview, cosmology, gender associations and symbol systems as it was for cultures like the Bantu from the time they were living in their original homeland to the periods when they were migrating outward. Had ironwork been central to the creation of the Egyptian state, for instance, which would be the equivalent to the Bantu case where it appears to have been with them prior to their expansions outward from their homeland, the Egyptians could have found alternative production methods or necessary resources for production and been able to continue the technology in earnest.

Unfortunately, because traditional ironworking began to cease in ancient Egypt prior to the ethnographic age we may never know whether or not the ancient Egyptian ironworkers shared some of the beliefs we know about the Bantu. Did they see heat as equally transformative? This is a question because many pyrotechnical skills (glass and ironworking for instance) appear to arrive around the same time in the Eastern Mediterranean, could this be the case in Egypt as well? We will revisit many of these questions in the last section. At present, we can at least begin to establish the movement of iron in this region (see Map Appendix D and final section in Appendix E for the chronology).

Let us now contrast the historical example of the Bantu, a long-term iron producing culture, with two others that had more short-lived iron production. In the next sub-section we look to another Nilotic culture whose historiography is much more closely tied to that of ancient Egypt and for which we have to return to primarily archaeological and historical analysis. The story of the next two cultures, Meroë and Aksum, are ones in which iron production appears to have diffused into the populations through means that will be postulated below. In the case of Meroë the end to the peak of their iron use appears to have been affected by the rise of Aksum. We will ultimately be able to see how historical factors affect iron use which is instructive since some rather similar causes do appear to have affected Egypt's iron use as well.

Meroë: a focus on "origins of iron production in Africa" diffusionist theories. Nubia, the other great Nilotic culture, was the rival to Egypt for the most ancient civilization in Africa. Its chronology can be separated into a Bronze Age phase (c. 3,000-

1,000 BCE) followed by the Napatan-Meroitic period (c. 1,000 BCE-350 CE). The latter age is named for its two successive urban capitals, Napata and Meroë, that followed the Bronze Age capital Kerma in supremacy in the region (O'Connor, 1993, xi). For reasons that are still debated, the center of gravity of the Nubians moved southward twice, possibly in accordance with a desire to retreat and create distance from the competition of the power of Egypt (first controlled by pharaohs, then by the Hellenistic and Roman rulers). Alternatively, the Nubian rulers could have been interested in achieving greater control over peoples and resources further south, upriver (O'Connor, 1993, p. 2; Falola, 2002, p. 56).

In the history of iron in Egypt and larger Africa it is the capital of Meroë, located between the fifth and sixth cataracts on the eastern bank of the Nile to the south of ancient Egypt in the modern day country of Sudan, that has captured the interest of scholars for over a century. Some knowledge of the city goes back much further into antiquity. Four hundred years after Herodotus another Greek historian, Diodorus Siculus, called the area the "Island of Meroë," a term by which it is still known in its designation as an UNESCO World Heritage site and some of the literature of the region although calling it an island is certainly inaccurate (Shinnie, 1967, pp. 13-16).

Nonetheless, Diodorus believed Meroë was located *in* the Nile itself as an island rather than alongside it, and thought that it had been founded by the Persian king Cambyses. However incorrect that may be, researchers like Shinnie have noted the area is actually bounded by rivers on three sides suggesting that these early authors did have some understanding of the geography of the region although they had not travelled there themselves (1967, p. 16).

Six iron slag heaps in the "Birmingham of ancient Africa." Numerous modern researchers note that it was Meroë's appearance in the early twentieth century that gave scholars an indelible impression that affected their understanding of the civilization as a major iron producer and their belief it was the origin point from which iron production techniques diffused to much of Africa. Garstang began the first excavations in 1909 which included the remnants of iron production (Rehren, 2001, p. 102).

Six low, black hills of slag rose in marked contrast against the sand and sky along the Cape-to-Cairo railway which caused the archaeologist Sayce who visited Garstang's excavation in 1912 to proclaim rather infamously that it must have been the "Birmingham of ancient Africa" (as examples of the enduring impact of this line it is quoted in Oliver & Fagan, 1975, pp. 38-39; Shinnie, 1967, pp. 160-161; Rehren, 2001, p. 102). The full quote is even more instructive because Sayce's central observations and conclusions made their way into the following literature for many years to come and continue to be cited when ideas about Meroitic iron are addressed.

> Mountains of iron slag enclose the city mounds on their northern and eastern sides, and excavation has brought to light the furnaces in which iron was smelted and fashioned into tools and weapons.
>
> Meroë, in fact, must have been the Birmingham of ancient Africa; the smoke of its iron-smelting furnaces must have been continually going up to heaven, *and the whole of northern Africa might have been supplied by it with implements of iron*. [Sayce's letter quoted in Wainwright, 1945, p. 22, emphasis mine]

This viewpoint ultimately contributed to the diffusionist theories that followed and then even expanded upon his suggestion. A.J. Arkell (1966) and P.L. Shinnie (1967) argued that iron-production techniques came to Meroë and the Sudan from the Egyptians and then spread throughout the continent (Okafor, 1993, p. 432). Shinnie's assessment was that the Assyrians had introduced iron products to the Egyptians in great number without being the impetus for them to begin producing iron. He believed this could be demonstrated by the fact that in the 5th century BCE Herodotus noted that the Ethiopian mercenaries in Xerxes' army used stone rather than iron for their arrowheads. Shinnie insisted that the very first people to introduce iron as far south as Napata had been Greek and Carian mercenaries from the army of Psammetichus II but that very few of their objects ended up in use there. It was not until the 4th century BCE that iron models of tools were discovered in the foundation deposits of the Kushite king Harsiotef's pyramid and even then, it was not until the 1st century that iron became plentiful. How it was introduced and from whom the technology came were complete mysteries then as now (Shinnie, 1967, pp. 161-162).

Shinnie did offer four propositions that remain important: 1) the methods of smelting were probably similar to ones that had survived almost into present day, namely, smelting the ore in furnaces fired by charcoal; 2) the real reason that iron production became important at Meroë was that the city had two basic necessities, ubiquitous iron ore and abundant groves of acacia trees to produce the charcoal (a situation that we may contrast to Egypt's well known lack of trees); 3) the production of iron was what contributed to Meroë becoming a great and long lasting regional power; and 4) that

Meroë was the probable center of diffusion for ironworking techniques[34] (pp. 161 & 167).

It was Bruce Trigger's 1969 article "The Myth of Meroë and the African Iron Age" that would challenge these viewpoints and set the tone for the succeeding decades of research. Trigger first took issue with ideas that came from Shinnie's mentor, A.J. Arkell. Arkell's version of the diffusionist theories will sound familiar for they are quite similar to the current theories about the spread of ironworking via the Bantu with a few alterations, such as the key transmitter of the cultural advances. Arkell persuasively argued that ironworking had spread with a suite of features including divine kingship and brick architecture from the Meroitic civilization across the savannah to West Africa. Trigger was especially critical of the "selection of pseudohistorical ornamentations" such as the idea that these traits were carried westward by the Meroitic royal family fleeing from their Aksumite conquerors (an idea Trigger notes is not unlike the once fashionable belief that the Renaissance in Western Europe could be explained as the result of scholars fleeing the fall of Constantinople). [Trigger, 1969, 25]

Trigger noted that there was so much momentum in the scholarship at the time of his publication that Meroë was on its way to being accepted as the "hearth of sub-Saharan African civilization and a principal transmitter to the rest of the continent of traits coming from the north" (p. 25). Instead, he argued that the iron objects that showed up in the Meroitic context during the Egyptian Twenty-Fifth Dynasty (722-655 BCE) appeared to

[34] Shinnie does equivocate on this point. Although Okafor cites him as a diffusionist, Shinnie did clearly state that the evidence was only circumstantial. In fact, he declared that it was "no more than supposition" that Meroë was the main center of diffusion for iron production throughout sub-Saharan Africa and he even wondered if there were other major iron producing centers (Shinnie, 1967, 167-168).

have been imported from Egypt in their final form. Trigger's argument that has implications for this study is that he found that they did not appear to be Egyptian either. Iron tools found in Meroë at this time were socketed, which varied from the Meroitic tanged tools. However, socketing was not an Egyptian feature in tools at this time either, it was a feature found in Greece and the ancient Near East. Therefore, Trigger argued that the most likely scenario was that Egypt was importing tools in the Twenty-Fifth Dynasty and they made their way as far southward as the Meroitic culture which was strongly influenced by many aspects of Egyptian culture at this time.[35]

In all the intervening years since Trigger's seminal article there has been a vigorous and inconclusive debate between those who believe iron was invented independently in East Africa and those who believe it was invented elsewhere. Those who believe in independent invention note that the furnaces of Tanzania, Rwanda and Burundi are slag-pits in contrast to the slag-tapping brick furnaces at Meroë. Others find this ignores the chronology for the slag pits are from the first millennium BCE and the brick furnaces are from the first millennium CE. At present there are three key reasons why neither side has been able to compile enough convincing evidence: dates between 800 and 400 BCE cannot be resolved, dates prior to 800 BCE are not secure and there are no in-situ examples of Napatan or Meroitic furnaces from the early first millennium (Killick, 2009, p. 411). I favor the idea that Meroë was not the source of sub-Saharan ironwork but that does not necessarily mean that it was an independent invention either.

[35] Meroë was also influenced by Hellenistic culture especially with respect to pottery decorations/styles via Egypt with the bulk of influence occurring between the mid-first century BCE and the early third century CE (Török, 2011, p. 316).

The Meroë Archival Project is currently re-assessing Shinnie's work and can be expected to contribute to this discussion. So far they have found that he was so interested in chronology that he did not focus on the social questions. He used the box method, emphasized verticality, left many baulks unexcavated and did not believe the small finds were especially interesting (Boozer, 2014). Therefore, we cannot currently situate the social context of iron production at Meroë with any degree of specificity and the routes of the technology's diffusion at this node are a matter of conjecture based on incomplete knowledge. However, we can say more about how they may have exited the heights of their Iron Age. In the following section we will look at the kingdom that became the next major center for iron production.

Aksum: iron-using Christian kingdom and successor to Meroë. Aksum (Axum), located in the highlands parallel to the Red Sea on the Tigray plateau about 31 miles (50 km) from the border of Eritrea, was the predecessor to the modern country of Ethiopia. It came to prominence after Meroë and took over its place as a regional power from the 4^{th} to 8^{th} centuries CE. Excavations began in the area in 1906 and produced evidence for a kingdom with large trade networks that involved a prominent place for iron and a culture that produced distinctive architecture and extraordinary monuments including large, carved stelae for their rulers such as the one remaining standing example that soars to 70 feet (21 meters) high (Oliver & Fagan, 1975, pp. 42-44 & Severin et al., 2011, p. 1).

"Pre-Aksumite culture"as a combination of Arabian and East African traits: fact or fiction? Aksum first became a great power in the 4^{th} century CE but since the 17^{th} century, (culminating in the 1960s and 1970s), researchers have argued that its roots extended backward in time to its first settlement by Semitic-language speaking people from southern Arabia as early as the 7^{th} century BCE. The Bronze Age cities of Yeha in the Tigray region of northern Ethiopia and Mahar in the modern state of Eritrea are two important examples of the early "Pre-Aksumite"[36] culture. The significance in the history of ironwork in the region is that the people of Yeha were buried with iron tools, once seen as part of a larger culture that was essentially the result of the process of acculturation that happened when two regions' influences collided (Oliver and Fagan, 1975, p. 42 & Fattovich, 2009, pp. 276-277). Here is a summary of that argument produced by Butzer that includes all of the archaeological theory that peaked in the two decades preceding his publication:

> *The conventional view is that Axumite culture owes its origin to a graft of Arabian institutions and technology on to East African roots.* The basic traits attributed to South Arabia are writing, religious and political symbolism, architectural and irrigation technology, Near Eastern cultigens such as wheat and barley, and possibly the plow-although the Semitic language may considerably antedate the archaeological evidence of Arabian influences in northernmost Ethiopia ca. 600-200 B.C. […] The critical East African traits are thought to have been cattle pastoralism and the cultivation of a variety of indigenous plants (including the grain *teff*, the oilseed, *nug*, and the false banana [*Musa ensete*] […] [Butzer, 1981, p. 472 , emphasis on first sentence is mine]

For some researchers another one of the influences that arrived from the ancient Near East was the knowledge of ironwork. In fact, linguist Christopher Ehret, a chief proponent of the idea that African ironworking was an independent, indigenous

[36] The Pre-Aksumite culture is also known as the Ethio-Sabean period (Fattovich, 2009, p. 277).

development, the case of Aksum is a significant anomaly in this regard, “In just one region of sub-Saharan Africa, the Horn of Africa, did the first knowledge of iron apparently come instead from the Middle East, before the African invention of iron-working reached the area” (2002, p. 162). Several researchers went so far as to argue that Aksum became the point from which ironworking spread throughout the rest of sub-Saharan Africa. This is an impossibility, as Mapunda notes, because ironwork in many African sites predates the technology’s arrival in Aksum (Trigger, 1969 and Sutton, 1971 refuted in Mapunda, 1997, p. 120).

Were these iron-using people really properly explained by the idea that they had a combination of South Arabian features overlaid onto an East African substrate? Fattovich focused on the city of Yeha and found evidence that could be interpreted in several ways. The site is widely regarded to be the most impressive “Pre-Aksumite” settlement from the mid first millennium BCE with noticeable South Arabian influences (2009, p. 275). Fattovich employed his own earlier work and reviewed the archaeological research from the site in order to compare it to other sites across the region. In 1980 he grouped the ceramics from Yeha into 19 different types based on the classification system developed by W.Y. Adams for Lower Nubian ceramics. Distinguishing features involved separating the ceramics by distinct fabric types, shape, surface treatment and color. This classification scheme served him in his 2009 study as well (p. 277).

He was able to summarize his findings relating to three main phases at the site. One will note numerous South Arabian influences. Yeha I had examples of orange, gray fine ware and a red coarse ware including vessels similar to those found in Yemen such as amphorae and bowls or jars with ringed bottoms. Yeha II featured very significant changes: a Great Temple, palace and elite cemetery indicated a more hierarchical structure to the polity. The ceramics were more impressive as well; fine ware in red-brown, polished dark-red, black-topped polished, pink, light brown and brown were the most common. Importantly, it was this phase that saw the introduction of iron occur in two tombs, chamber B of tomb 6 and the shaft of tomb 4. Copper/bronze weapons were found commonly. The Great Temple and some of the ceramics appeared similar to examples from Yemen once again. Yeha III continued to produce iron artifacts at the same time there was a reduction of black-topped polished ware. Coarse red and black polished wares were discovered and fine wares that were red-orange and dark brick red in color were also found (pp. 281-282).

While there were similarities between Yeha and South Arabia, particularly Yemen, Fattovich found problems in trying to make this a wider "Pre-Aksum" culture. The ceramics of Yeha I were *not* similar to those from the earliest stratigraphic levels of Matara in Eritrea, instead they only appeared similar to other ceramics found close by in the central Tigray. The ceramics of Yeha II *were* similar to sites in a wider area including central Tigray, Aksum and Matara. The ceramics of Yeha III have been found in the region extending from Yeha to Aksum, but no further. [pp. 282-284]

Finally, the evidence he reviewed offered some other intriguing clues. It suggested that the central Tigray had three distinct ceramic traditions that represented an indigenous, sedentary people who were not alone. In his assessment, they were interacting with cattle herders that were at their margins that probably contributed to an exchange network that connected the highlands, lowlands and coastal regions (p. 284). While he was able to glean a lot of information from the admittedly patchy evidence and only partially excavated sites to which he had access, he still noted the following:

> Identification of the Tigrean/Eritrean ceramic tradition of the mid-first millennium BC with a specific polity […] is questionable in the absence of a more detailed analysis of the rate of similarity between the ceramics in the single sites, which might support or reject the existence of a discrete archaeological culture, and a proper archaeological context for most buildings and artifacts in a South Arabian style in the region (p. 287).

Once again, we find that discovering the origins for ironwork is an elusive task based on very wide guesswork and evidence that is arranged into widely speculative over-arching theories. At every stage, a closer view, uptick in scrutiny or a greater base of evidence only increases the doubts about the presumed origins of ironwork and its place in the societies in which it is found.

Aksum in the first through fourth centuries. The kingdom of Aksum was also known about from the same *Periplus of the Erythraean Sea* mentioned previously in the section on the Bantu that was produced by a 1st century merchant for a Greek-speaking audience. As we mentioned earlier, in it the author describes an area near a deep bay where "Calf-Eaters" and Berbers were governed by a ruler named Zoscales said to be "miserly in his ways and always striving for more, but otherwise upright, and acquainted with Greek literature" (Chapter 5). The area was rife with imported goods including robes from Arsinoë, undressed cloth made in Egypt for the Berbers, axes, adzes and swords, wine from Italy and iron from an undisclosed location "which is made into spears and used against the elephants and other wild beasts, and in their wars," (Chapter 6).

More iron and steel was imported from India along with their cotton cloths, muslins and other items. In return, the people of Aksum were a chief exporter of ivory, tortoiseshell and rhinoceros horn (Chapter 6).

Since the people of Aksum were buried with iron before they became a great power and were known to be importing iron in the first century, it begs the question were they ever producing iron on their own? What is clear is that in the 4th century the court of Aksum underwent very serious changes that affected their history and the history of iron production in the region. The court famously converted to Christianity at the same time it became a regional power under the reign of a king known as Ezana (Oliver and Fagan, 1975, pp. 43-45).

The events are recorded in the 6th century *Ecclesiastical History* by Rufinus. The story that he tells is that there was a Christian philosopher from Tyre and his two young protégés, Frumentius and Aedesius, who travelled by ship during the reign of Ezana's father and became shipwrecked on the coast of Aksum. Unbeknownst to the passengers, the treaty that had protected travelers under the auspices of the Roman Empire had expired so the people of Aksum killed everyone aboard the ship except these two children. The children were then placed in the services of the crown, one becoming a cup-bearer and the other, Frumentius, becoming a secretary. Upon the death of Ezana's father they were given their freedom but agreed to stay at which time they used their influence to get fellow Christians to settle in the area and found churches. Frumentius even went on to become the bishop of Alexandria. After rising to this role Frumentius was given the duty of returning to Aksum to tend to the burgeoning new Christian community. He took this opportunity to convert Ezana himself to his religion which then facilitated its spread even further (Oliver and Fagan, 1975, pp. 43-45 & Thompson and Ferguson, 1969, 58-59).

Meanwhile, when Ezana ultimately succeeded his father he became a successful conqueror whose own inscriptions recorded his expedition to the "island of Meroë." The area was already overrun by two groups known as the Red and Black Noba. Ezana's inscription states that "the Blacks waged war upon the Red Peoples, and a second and a third time broke their oath, and without cause slew their neighbors and plundered our envoys." For Ezana's part he burnt down their towns and then, "my people seized their iron and their bronze" along with their meat, the images in their temples in addition to their corn and cotton (Oliver and Fagan, 1975, p. 45).

At this point Meroë went into a decline and Aksum became the chief power in the area leading to a long held debate about the role of Aksum in the changing fortunes of Meroë. Did Meroë fall because of the depredations of Aksum or had the processes of its decline already started long before? Which explanation is better is still unknown, but the end result is that Aksum was on a cultural upswing while Meroë was on a downswing, either worsened or precipitated by Aksum.

While the details of where and when iron arrived, the social context of iron production and exactly *why* these polities rose and fell in their regional importance are debated we have at least been able to establish the order of their apogees of power and the time periods when iron came into heavy use in each area. They appear to have achieved ironworking capabilities because of their contacts with other regions and in the case of Meroë been greatly affected by the growing power of Aksum. I would argue that in addition to establishing more details of our understanding of the routes along which iron production methods spread, it also informs our understanding of how the course of iron production can be affected by one's neighbors both at its inception and when that iron-producing power is on a decline. Although my chief argument is that ironworking was not as deeply ingrained in ancient Egypt as other metalwork which contributed to its late adoption as an important metal and subdued use overall, there were extremely important historical factors within the Roman Empire that contributed to the drastic reduction of iron use as well. To a certain degree this mirrors some aspects of the history of Meroë. We will ultimately see in the final section that the ancient Egyptians did experience disruptions at home including the incursions of various populations.

In the case of the Eastern Mediterranean we are greeted with much more evidence including some generated from ancient literature. We will also finally be able to encounter a social theory for the technological evolution of iron production that we will compare to Egypt in the final three sections of this study.

Eastern Mediterranean: Greece and the ancient Near East. Greece is of particular interest to the history of iron in Egypt because as we discussed above there are numerous scholars that cite Greek mercenaries and/or craftsmen as the source of smelting techniques that brought Egypt into the Iron Age. For the history of Greek iron production there are some literary sources as well as a burgeoning amount of archaeological studies of increasing sophistication that tell the story of its inception and the growth of its use. Scholars trained in the classics had numerous sources to provide clues about iron production from Greek and Roman writers scattered across space and time. There were a few stories about the origins of iron too. In Book I Chapter 25 of Herodotus' *Histories* he describes a king named Alyattes, the Lydian, who had waged war against the Milesians. After falling ill and then recovering from a sickness he dedicated a great wonder to the oracle of Delphi: a mixing bowl made of silver welded to an iron stand. This treasure was said to be the greatest of the votive offerings to the oracle and was the creation of the man who discovered the process of welding, Glaucus of Chios. Thus, the process of welding iron was said to be an import from the East in the 7th century BCE (Scarborough, 1976, pp. 49-50).

Some argue that the Greek methods that were first developed for iron smelting were *not* impressive, in fact, must be considered "spotty at best" (p. 50). The problem was that Greek furnaces could not reach 1225 degrees Celsius which was required to produce pig iron so they produced wrought iron since it only required temperatures of 700 degrees. This resulted in the necessity of re-smelting, new techniques for specialty items and an interest in long-distance trade. By the age of Plutarch (50-120 CE) fragile iron objects like needles and clips were quenched in oil rather than water with the belief that this process preserved their shapes. These were highly sought after goods across Europe (p. 50).

Yet again the *Periplus of the Erythrean Sea* is applicable for it is this work that makes it clear that both Indian steel and iron were desirable trade commodities (part 6). In addition Spanish steel was highly prized. Apparently it was produced in a remarkable fashion that became well known by the Roman era (c. 30 BCE-395 CE). In Plutarch's

Moralia: On Being a Blabbermouth he noted that the Celtiberians buried iron in the earth, dug it up and cleaned off the impurities revealing steel which was then forged again to create much sought after blades (Scarborough, 1976).

John Scarborough, a scholar of the Greek classics who produced a book meant to inform curious students from his survey course about the questions that were rarely answered in textbooks, was able to recreate a truly prodigious list of objects iron-workers produced from the works of Plato and the other sources above:

> Blacksmiths made everything from their own tools—like hammers, smalls and sledges, clawed pincers, and saws—to carpenter's tools that included hammers, beetles, lathes, planes, augers, spokeshaves, and gimlets. All blacksmiths battered out large nails, as they continued to do until the nineteenth century, but smaller nails for shoes required special care. Made of iron, as were the larger kinds, the smaller nails for shoes fastened soles. A brisk trade was carried on in special knives, awls, tweezers, and clamps that were needed in a shoemaker's shop along with the wooden lasts […] The finest [iron] tools for the special professions were often inlaid with bronze and ivory work, and no doubt their exotic origin gained them good prices in foreign marketplaces (p. 51).

The degree to which scholars of Greece have been able to reconstruct iron production and trade routes largely through literary sources is enviable, particularly when other areas of the world have no indigenous written primary sources discussing iron at all, like the Bantu before the modern era.

How the Greeks Learned about metalworking from the Egyptians. From the point of view of Egyptology the most surprising finding is that some historians trained in the classics believe that "the sophisticated metalworking industry in Greece owed much to Egypt" (Mattusch, 2008, p. 423). Although it is widely acknowledged that the Greeks were influenced by the Egyptians in monumental stone building and sculpture, the fact that the Greeks worked in iron with a greater frequency centuries earlier than the Egyptians and that they may have introduced iron smelting to Naukratis and Tell Defenneh means that the discussion has usually centered on how the Greeks influenced the Egyptians.

However, within Greek literature there is evidence that the Egyptians' millennia of metalworking also influenced the Greek tradition. Not only were the (possibly) Greek smiths of the Delta towns bringing an ironworking craft with them, they appear to have been learning from their surroundings at the time. The most overt evidence comes from texts. Diodorus (1.98) claimed that the greatest sculptors Telecles and Theodorus, sons of Rhoecus visited with the Egyptians. From them they learned how to use the Egyptian system of determining how to represent a figure by using a formula for its proportions. The sculptor well-known from mythology, Daedalus, who built wings of wax and flew too near the sun, was also said to have produced sculptures that "looked Egyptian" (Mattusch, 2008, p. 423).

The Importance of the Archaeological Data. Although all of the above information concerning what kinds of iron objects were being produced could be gleaned early in the history of Greek scholarship, there was a seismic shift that occurred in the research in the 1970s thanks to the work of some extremely enterprising archaeologists well versed in statistical analysis.

In 1977 Maddin, Muhly and Wheeler—three scholars who would become important in the study of iron in this region— wrote a seminal article entitled "How the Iron Age Began" where they noted the extremely interesting fact that iron had been known as a "workable metal" throughout the majority of the Bronze Age but if you counted up every single known iron artifact from Southwest Asia to the western Mediterranean for the entire 2,000 year period you would find less than 500 pieces. As was the case for Egypt, most of these were "ornamental." By contrast, bronze artifacts numbered in the tens of thousands and included tools and weapons. The authors went on to argue that iron replaced bronze as the prominent metal for utilitarian purposes as a direct result of a shortage of tin.

The 1980s and 1990s saw a series of theories to be discussed below about why bronze was replaced by iron around 1200 BCE that have recently been reaffirmed. In an upcoming section entitled "The Late Bronze Age" we will examine the extent and possible causes of a series of calamitous events, re-ordering of many polities and destruction of empires, cities and societies known collectively as the "Bronze Age Collapse." Since this period directly precedes the arrival of iron it is natural that the events would have been seen as connected.

In a ground-breaking 1980 book edited by Wertime and Muhly called *The Coming of the Age of Iron* Snodgrass outlined the theory espoused and employed in the historical section that refined the chronology of Iron Age Egypt in this study. Many other observations and discoveries contained within this volume remain important to this day and he has re-affirmed his belief in many of them as recently as 2006 in *Archaeology and the Emergence of Greece*. Waldbaum reviewed the archaeological evidence in 1999 that is comprised of mostly corroded pieces found throughout the Eastern Mediterranean. Recently, Veldhuijzen argued that while the number of archaeological artifacts has increased since Snodgrass's 1980 study and Waldbaum's review, the state of knowledge has remained virtually unchanged. The same literary sources are cited then as now. He noted that little has been discovered about the methods of iron production although the overall story of iron in the region seems to be understood in a macro-historical sense (Veldhuijzen, 2012 & 2013).

The basic thesis is that iron first appeared in East Anatolia at the beginning of the 2nd millennium BCE, known so far from primarily funerary and ceremonial contexts. The occurrence of iron is also corroborated by texts from Hittite archives (palace and tax lists) as well as Assyrian and Greek sources. Iron then spread eastward into Assyria and then northeast into the coastal areas of the Black Sea of modern Georgia. At the end of the millennium the centers of iron production extended to the southeastern portion of Anatolia and northern Syria. Levantine iron production methods appear to have originated in northern Syria. After 1200 BCE iron production became increasingly utilitarian and more frequent in appearance, beginning first as arrowheads and knives until culminating in swords and other larger items. Between 1000 and 800 BCE iron became the main useful metal throughout the majority of the Eastern Mediterranean (excluding Egypt) although as we noted from Snodgrass's summary, a surprising fact about the "Iron Age" is that bronze never disappeared as a useful metal, in fact its frequency and skill of manufacture only increased. Among the finds that demonstrate the importance of iron is the startling discovery of 160 tons of iron blooms, bars, billets and other objects in the 8th century palace of Sargon II at Dur-Sharrukin, (present-day

Khorsbad). Then the literary sources disappear and the "Dark Age" begins. [Veldhuijzen, 2012, pp. 239-240]

Nonetheless, some of the theories from this era have been discarded as a result of further investigations. For instance, it was initially believed that Colchis on the Black Sea of coastal modern Georgia was the origin of iron production but it has become apparent that they were the recipient of Anatolian methods instead (p. 239). The theory that the advent of the Iron Age was based on a tin shortage that resulted in the inability to produce bronze and a related idea that copper also came to be scarce have both appeared to be incorrect. These theories argued that at the end of the Bronze Age there were a series of calamities that caused a disruption in the trade networks of the time period among which tin and copper were included, both of which are required to produce bronze.[37] The few texts upon which the idea was based are ambiguous which has made archaeological investigation paramount. The findings to date have indicated that there was no dramatic increase in the number of iron smelting facilities around this time period (in fact, there are simply few examples altogether) and that no bronzeworking facility gave way to the production of iron as one would expect had the theories been correct (Mirau, 1997, pp. 104-106). Further arguments that there were shortages have fallen apart as well. For instance, in the early to mid-1980s Wertime and Stager insisted that charcoal—the main source of fuel for carburization—came to be hard to obtain. More recent evidence has contradicted this proposal by proving that extensive deforestation did not occur in the Mediterranean until the 19th century (Mirau, 1997, pp. 106-107).

[37] In the section on the Late Bronze Age, we will discuss the calamities, some textual evidence from this time period and the trade circuit that had connected the ancient polities prior to these disruptions.

Furthermore, there were two widely believed notions based on textual evidence that have become untenable. In the section about the Late Bronze Age we will discuss the arguments that either the Hittites or Philistines controlled the secrets and access to iron production. Archaeologically, Muhly et al.[38] were able to demonstrate that the Hittites were capable iron-producers but did not possess exclusive or even particularly advanced methods in comparison to their competitors. In spite of a biblical passage that very specifically claims the Philistines prevented the Israelites from iron production, a 1990 study by McNutt showed that both Philistines and non-Philistine sites had limited but similar access to iron tools and weapons from the 12th to 10th centuries BCE (Mirau, 1997, pp. 107-108). Veldhuijzen notes that the Iron Age site of Tel Beth-Shemesh in the Levant has clear evidence for smithing activity, right at the edge of the Philistine territory offering direct evidence that contradicts the way the scripture presents the Philistine monopoly of iron (2012, p. 246).

If all these once-viable theories have come to naught, how are we to proceed and what suppositions actually do fit the evidence? The subsequent argument is the one that I will employ in the remainder of this study. We will discuss the nature of the massive destruction of ancient empires, states, city-states and polities that occurred in the Late-Bronze Age/Iron Age Transition in the "Late Bronze Age" section but suffice it to say for now that the old order disappeared to such an extent that Egypt was no longer as active on the international stage, at least not in the way it had been at the height of the New Kingdom (c. 1539-1077 BCE). An even worse fate met other great powers of the Eastern Mediterranean and much of Mesopotamia. Population studies indicate increased

[38] Muhly et al, 1985;1990 (In Mirau, 1997, p. 107).

populations overall and a process of “de-urbanization” and in-migration to the countryside followed which created new political structures and new economic relationships between metal producers and their customer base. Budd and Taylor[39] argue that in the Levant the customers for Bronze Age metal were in a patron-client relationship with the producers. The theory to which several authors subscribe is that after the complete collapse of the power-centers of so many of the great kings and other patrons, metalworking became de-centralized just like the political structures. [In Mirau, 1997, pp. 108-112]

As we stated at the beginning of this section, a question that I would like to address in the final three sections is under what conditions did iron become a luxury good and exactly *why* did it later become a utilitarian metal? I would argue in accordance with the above theorization that these changes were motivated by the changing nature of the population, the disappearance of the previous patron-client relationship and the new ability to innovate. The greater populations appear to have led to an increased need for agricultural implements (which have historically been the basis for weapons as well[40]), i.e. “utilitarian” products. Up until this time agricultural tools for the masses at the height of the “Bronze Age” were actually still made of stone. Quite ironically the so-called Bronze Age could be called a continuing Stone Age for the masses. In the aftermath of the Bronze Age collapse, the metalworkers were no longer tied to the kings and other

[39] Budd and Taylor, 1995 (In Mirau 1997, p. 110).
[40] Example of a historical source claiming ancient smiths first made agricultural tools, then weapons, is found in Juvenal (*Satires* 15. 165-170).

powerful patrons so they would have had to be more responsive to their new client base's every day, practical needs and had the incentive and wherewithal to experiment more widely. Rather than providing for the needs of the few great patrons, metal producers would have needed to produce many different kinds of objects for people from all walks of life that were economically accessible. In other words, this explains the new uses of iron and the increased incidence of iron products. In this way we will see the Iron Age was a more far-reaching affair, one that actually reached the masses, hence the greatly increased number of finds from this era. [Mirau, 1997, pp. 108-112]

Later when the "Iron Age" societies became larger in scale, more centralized and powerful they were well placed to create an industrial form of production of iron, i.e. the full potential of the Iron Age was reached. Contrary to previous arguments it does not appear that one group like the Hittites or Philistines were in control of access to iron or secrets regarding its production (Mirau, 1997 pp. 108-113 & Veldhuijzen, 2013). Iron became a plentiful metal in numerous Eastern Mediterranean societies with Egypt being an intriguing exception for another half millennium.

This set of arguments is particularly appealing to scholars of the Levant. In the remainder of this study I would like to apply them to the Egyptian evidence as well in order to discover why the advent of the Iron Age was so late in Egypt in comparison to the rest of the Eastern Mediterranean. In the final three main sections we will look at the first phase during which iron came into use in Egypt. There is much more to the story of iron than mere technological change, its evolution appeared within a social and international context at every stage. How did the adjustments in social conditions, new economic realities and changing political structures and the international relations between polities affect the use of iron over time? In the first remaining section we will ask was iron indeed a luxury good in Egypt? Who was using it, who was creating it, how did iron come to be used in the first place, how was it perceived and what was the substrate of the society like at this time? We will look widely across the region and in depth at a few locations within Egypt to answer these questions. In the section that follows we will look at the transition period between the Bronze Age and Iron Age. What exactly turned iron into a practical, utilitarian metal for the masses and why did this change not occur in Egypt when it did across the rest of the region? Finally, we will look to the Greco-Roman era when we can actually view the cult activities of one iron producing group over a fifty year period. Our last questions will be how were the iron-producers organized and what exactly caused the ultimate disruption of the widespread use of iron in Egypt?

Iron in the Predynastic

Summary: The earliest examples of Predynastic era ironwork in Egypt come from two graves from the Naqada II C era at el-Gerzeh c. 3300 BCE. Although the graves appear to belong to commoners they are found in assemblages that include a mace head, other valuable beads and palettes suggesting that iron was a luxury good at this time as authors like Snodgrass would note. We should recall that the other Predynastic item not discussed in this section was a ring found at the cemetery at Armant that subsequently disappeared. It too fits the pattern of being an apparent luxury good. The graves have unique features including an individual whose head was decapitated. This early burial practice was likely significant and many theories regarding it including my own suggestion are discussed.

A look at other contemporary sites in Egypt as well as Nubia, the Levant and Mesopotamia shows that this was a time period when there was much more increasing social complexity than earlier studies indicated. This includes new forms of domestic architecture, craft specialization, more efficient food production and more effective defensive walls. It is my contention that 1) skills in ironwork may have been transferrable from earlier copper or goldwork either within or outside Egypt and 2) that everywhere one sees technological advances in ironwork at this time there was a sufficient substrate of complexity provided by the society that enabled and influenced it and 3) iron was associated with higher status goods and probable social enhancement.

Map 6. Sites in Lower Egypt (Northern Egypt) (Teeter, 2011, p. 14)

We will now begin looking at three time periods of Egyptian history in closer detail in the last three secions of this study. The location and time period during which the first iron appeared in Egypt coincides with a very interesting set of circumstances. In this section we will see that during the Naqada IIC era (circa 3300 BCE) very remarkable and even occasionally shocking burial practices began to emerge before ultimately dying out. We will find that there were probable migrations of large numbers of individuals bearing new forms of pottery from Upper Egypt to Lower Egypt. There were also new forms of architecture and signs of increasing social complexity that appeared everywhere from the Delta, to the Levant, all the way down to the borderlands of Egypt and in Nubia under some possible Egyptian influence. Into this set of circumstances the very first known few examples of iron production anywhere in the world appeared. As we have already seen in the historical section they have been determined to be meteoric in nature.

We have already noted in the linguistic sub-section of the historical section that by the Pyramid Age iron did have some associations with the king and the heavens. The gates and the vault of the heavens were comprised of *bỉꜣ* which many scholars believe was a term for iron. The king would descend from Horus' arms on bands of iron in the afterlife. The throne, scepter, bones and limbs of the deceased pharaoh were transformed into this same substance in the afterlife. Likewise, the weapons of Horus and his brother-god Seth's *mtꜣyt*-spear used to protect the barque of the sun-god from the evil snake Apophis were made of *bỉꜣ*. The Opening of the Mouth ceremony was performed with an adze of iron (made from Seth's bones). These examples, however, all post-date the Predynastic era by centuries: so how was iron seen during this earlier time period when Egypt was becoming increasingly complex to a degree that would ultimately permit the creation of the first state? In this section we will explore the truly widespread evidence for increasing social complexity occurring not only in Egypt, but other Near Eastern and Nubian settings which I argue is often a precursor to early advanced metallurgy. Nonetheless, we will not see any deep integration of iron use into the wider society as the examples of iron are actually associated with somewhat atypical burials. Let us begin by seeing what we can demonstrate about the world in which worked iron makes its first appearance.

El-Gerzeh during the Naqada IIC Era

The site of the very first discovery of iron in both ancient Egypt and the world occurred in a rather small cemetery located on the western bank of the Nile south of a road between el-Riqqeh and the Fayum. It was named el-Gerzeh after the nearby village (see map 6 above; Wainwright in Petrie; Wainwright & MacKay, 1912, p. 1). The first two primary investigators of the cemetery were the student of Sir Flinders Petrie who made such interesting observations about the possibility that early iron was meteoric, Gerald Wainwright, and his colleague, the Roman archaeologist J.P. Bushe-Fox. The extraordinary significance of the cemetery was recognized by Wainwright immediately as it was the first site to bear clear evidence of the southern Predynastic (Naqada) culture of Upper Egypt in Lower Egypt. Up until that point the closest published remains of this culture type were from Abydos 200 miles (300 km) away (Wainwright in Petrie et al., 1912, p. 1 & Stevenson, 2009, p. xvi). Therefore, when the excavation report was published in 1912 it provided a record of what appeared to be the early phases of the widespread acculturation of the Naqada culture northward to the rest of Egypt that would culminate in the creation of the world's first politically and culturally unified state.

Unfortunately, the site itself has suffered so much from urban sprawl and increased agricultural production that Butzer declared it had been entirely lost by 1966. Fekri Hassan disagreed with that assessment and found that some of the site remained present but admittedly had mostly disappeared under a modern cemetery (Stevenson, 2009, p. xix). Nonetheless, el-Gerzeh is important for this study because enough documentary evidence of the site remains from the early 1900s that it became the foundation for a study of social identities and mortuary practices in the Predynastic era conducted by Alice Stevenson and published in 2009. The original 298 tomb cards of which 288 burials were available for study,[41] cemetery plan and 272 artifacts housed at various museums provided the foundation for Stevenson's analysis (Stevenson, 2009, pp. 3& 8).

Stevenson's study offers several points that indicate how iron was viewed at this early stage by its users if not by its producers. In addition, we will see that the original site report by Wainwright offers great detail about the two graves that contained iron and even some important speculation about one of the more mysterious aspects of the treatment of one of the bodies of the tomb owners. We will then look to the Workers' Cemetery at Hierakonpolis and conclude by studying both settlement architecture and burial remains to determine what can be said about this period during which social complexity appears to have been increasing exponentially.

The burials at Gerzeh were open pit graves with oval, circular and rectangular shapes that only impinged on nearby tombs in three cases which Stevenson saw as very good evidence that there must have been some form of system marking the graves

[41] The first nine tomb cards correspond to plundered graves from the Second Dynasty according to Wainwright and one grave was accidentally given the same number, 110, which left 288 actual graves for Stevenson's analysis. Further complications arose from the fact that 39 graves were looted or from the New Kingdom and another 16 graves were heavily disturbed. The disturbed or looted graves were included in Stevenson's study because they still contained information she found valuable (Stevenson, 2009, pp. 8-9).

"highlighting the importance of social memory to the surrounding community or communities" (pp. 81-82). The bodies were laid on one side in the fetal position (p. 81). There was a slight preference to place the body on the left side with the head facing north and the face oriented to the east. The second most common orientation was similar to the most common Upper Egyptian arrangement: the body was placed on the left side with the head facing south and the face oriented to the west. Only 2.7% of the bodies were buried in the Maadi, Lower Egyptian style of placing the body on the right side with the head oriented to the south, facing east (pp. 148-149).

The majority of the graves were relatively small, ranging from $0.65m^2$ to $1.26m^2$ with the largest grave being $3.05\ m^2$. Contemporary Naqada IIC graves at Naqada T5 and Armant were larger and the famous painted tomb 100 at Hierakonpolis is much larger than the largest Gerzeh grave at 4.5 X 1.5m. Although six of the seven smallest graves housed children it does not appear that body size was the only factor in determining grave size. In addition, some of the graves had further investment from mud plastering, linen wrapping and possible wood-lining (Stevenson, 2009, pp. 186-188 and footnote 2 on p. 186).

The grave goods found at Gerzeh included valuable stones from turqouise to obsidian, ceramics, stone vessels, copper, lapis lazuli, rubbing stones, palettes and other special objects of which we will have more to say below. The cemetery bore evidence that the funeral rites incorporated consuming food and drink such as eight graves that had partial remains of cattle. In comparison to the Maadi culture of Lower Egypt that was contemporary to this grave site, this Naqada culture's grave goods represented so much more variety along with new burial practices that Stevenson concluded the people interred within were a new group who had migrated into the region from the south. In 1896 Petrie had stated that this Naqada culture was "wholly unEgyptian" but he later realized this was in fact an indigenous Egyptian culture (Stevenson, 2009, pp. 81-127 & Bard, 2008, pp. 96-97). So far, that later supposition has appeared to be true.

The most common grave goods in order of their occurrence were ceramics, stone vessels and thirdly, beads, which were found in 47 graves. Since the first pieces of iron were beads it is useful for us to know a little about their purpose. The tomb cards and Wainwright's notes revealed that at the site beads were positioned decoratively as necklaces, girdles, bracelets, around the head over the ears or as a fillet running around the forehead and there were some possible anklets. In Stevenson's assessment this indicated that beads were meant for "conspicuous bodily display" or were "chosen for particular amuletic qualities" (Stevenson, 2009, p. 115). At this point, I believe the evidence revealed below supports both views.

Tomb 133—the "specialist's" grave. Significantly, the only two burials that had iron beads— Tomb 67 which had seven iron beads and 133 that had two— were extraordinary in other ways as well (see Appendix B, Figure 5). Tomb 133 contained the most beads from any at the site and had what Stevenson argued was the most diverse assemblage. In addition to the meteoric iron there were gold and carnelian from the Eastern Desert, shells from the Red Sea and Mediterranean, 16 natural pebbles of canelian, green jasper and quartz and a lump of resin in addition to the tooth of a canine. Other objects included a shield-shaped palette with birds' heads incorporated into the design, an ivory spoon, a miniature pink limestone jar with obvious signs of use, a flint flake and a black and white porphyry bowl (see Appendix B, Figure 6). The entire body and all of the offerings were then covered over with a layer of mud (Appendix B, Figure 7). [Stevenson, 2009, pp. 195-198]

Stevenson argues that this was one of the wealthiest burials at the site but something more as well. She believes there is a difference between economic dominance, represented at another grave at the site,[42] and the domain of influence that this grave represents. She insists that "this eclectic display is striking" and the fact that the exotic goods derived from so many far off ends of the known earth "hints at a wide involvement within a multitude of specialized networks of exchange relations" (pp. 195-198). Certainly it is important that the objects arrived from such far ends of geographical space. To Stevenson, the type of specialist inequality represented at this grave site is similar to other clear cases of economic inequality in one way: both may allow for the beginnings of political inequality (pp. 196-197). In her interpretation, the mud covering over the body may have protected the goods or could have been a part of a funerary performance that hid the deceased from view as a "form of social remembering and forgetting" (p. 196).

For us it is important that iron occurs in one of the two most remarkable graves at Gerzeh. The second grave has even more characteristics of interest that will contribute to

[42] Stevenson argues both Tomb 133 and another not discussed here, 220, could be described as "rich" although in different ways. 220 was her example of purely economic wealth in comparison to Tomb 133 (an iron bearing tomb) which demonstrated a specialist's knowledge of far reaching geographic space (2009, pp. 193-194).

our final discussion about the nature of iron use and production in Egypt during the Predynastic era.

Grave 67 – the severed head with bead necklace burial: questions about rites of dismembership and symbols of kingship. I would now like to discuss the treatment of the body in one of the burials that contained iron, discuss the objects within the burial and offer a reinterpretation. Grave 67 was the other of two iron bearing tombs with a total of seven beads. It was also significant for having a few objects of which there are no other examples at Gerzeh: the only mace-head, the only harpoon and the only ivory vase (see Appendix B, Figure 8). The body of a "fair sized boy" was arranged in a very shocking and specific manner (Petrie et al., 1912, p. 5). The head was disarticulated from the neck and placed vertically to stand on its base with a necklace of beads arranged around it. Both the body and neck had strings of beads positioned around the skeleton. The necklace was embedded in the sand in a vertical plane as if it were still dangling from the severed head's neck (Stevenson, 2009, p. 196 & Wainwright in Petrie et al., 1912, p. 8 & 16). Other beads were arranged around the waist in a string and "one or two" loose beads were located at the skeleton's ankle (Wainwright in Petrie et al., 1912, p. 16). The order of the waist beads could not be determined, but the necklace that had four of the tomb's seven iron beads' original arrangement was preserved: 3 gold, 1 iron, 1 gold, 2 iron, 2 carnelian, 1 gold, 1 iron, 3 agate, 1 gold, 1 carnelian, 1 gold, 1 carnelian, 1 gold a slight space and 2 gold beads (p. 16).

Tomb 251 did not contain iron but was the other grave with a somewhat similar situation. The tomb's remains were headless but the grave was otherwise completely empty (Stevenson, 2009, 154). In total twelve of the skeletons at the site had been purposefully dismembered. Three pelvises, numerous hands and feet and in the case of Tomb 206 every single bone were disarticulated (p. 151). Both Stevenson and Wainwright summarized these findings in tables but Wainwright viewed these as much more significant as he believed they were all examples of “the ritual of dismemberment” at el-Gerzeh (Stevenson, 2009, p. 151 & Wainwright in Petrie et al., 1912, p. 10).

Wainwright believed the Pyramid Texts, Book of the Dead, Opening of the Mouth ceremony and the myth of the king Osiris who was dismembered and brought back to life by his sister-wife Isis all contained references that suggested that early in Egyptian history the deceased needed to undergo rituals in which their bodies were taken away from them with the expectation that they could receive them back in the afterlife. For instance, Unas’ Pyramid Texts included the declarations that his head, bones and flesh needed to be taken from him and then they would all be would be returned like his other possessions including his panther-skin, staff of office and his whip. In effect the body would be replenished and reunited with him like any other object of adornment (Wainwright in Petrie et al., 1912, pp. 11-15, for texts see Utterances 117, 219, 222, 224, 254 & 267). Interestingly, Wainwright proposed that by this time, the Sixth Dynasty (c. 2305-2118), this ritual was preserved only for the kings while the burial customs of the common people had evolved more rapidly. About the rites of dismemberment he stated the following: “[I]t is evident there there had actually survived these ritual ideas for kings, though many classes had abandoned them in practice for different and more civilized customs” (p. 13).

It is quite possible Wainwright was influenced by earlier findings further south at the first Predynastic burial site his mentor Petrie had found at Naqada. Petrie believed that the large, relatively wealthy tomb he found, T.5, had evidence of the secondary burial of several individuals *and* cannibalism. Six individuals were buried inside with numerous grave goods. The evidence for possible cannibalism was that several human long bones had teeth marks and marrow that had been removed with a tool. Since then it has been argued that the bones were not burnt indicating that the meat was probably not cooked and therefore not eaten. This still leaves the possibility in some researchers' minds that this is an early case of human sacrifice since sacrificing one's servants or slaves indicated the power of the rulers until the practice died out in early dynastic times (Hoffman, 1979, pp. 115-116).

Numerous recent discoveries have made Wainwright's observations impossible to ignore for the Predynastic era for other researchers, including this study. At the non-elite worker's cemetery at Hierakonpolis— HK 43— 21 individuals found in the 452 burials have cutmarks on the neck vertebrae including two complete decapitations where the head was then put back in place similar to Tomb 67 ("The Workers' Cemetery-HK 43," n.d., para. 1 &13). The site's graves have over 500 individuals, males and females from 16-65 years old from the Naqada IIB-IIC time period (which their investigators estimate to correspond to approximately 3650-3500 BCE), among which these practices were spread (para. 1). There was a particular treatment of the head that seemed reserved for one age group and gender. Five young men were scalped, their skulls bearing up to 197 cut marks on the vaults of their heads (para. 13). What is so surprising about all of these burial practices is that unlike the grave T.5 at Naqada none of the Hierakonpolis burials appear to be associated with any particular status—neither particularly high nor low—and the graves that were affected were scattered throughout the cemetery, rather than set apart (para. 13). For our purposes it is also significant that there were few beads and no iron at this cemetery even though the treatment of the body of several individuals was similar to Tomb 67 at el-Gerzeh.

In spite of possible evidence for the practice elsewhere, once again it was tempting to dismiss Wainwright's ideas for approximately one century. He made suggestions at the same time that have proved less than prescient, for example he argued that the cemetery of young children found at Tell Ta'annek were clearly the "remains of a widespread custom of child sacrifice," (p. 11) rather than seriously considering the possibility that infant mortality was quite high.[43] Stevenson believed the argument was outside the purview of her work, preferring to reference some of the discoveries below in passing. She simply felt that this secondary treatment of the body of Tomb 67 demonstrated that the people at Gerzeh were more similar to southern Egyptians than the Maadi culture of the north and that they had a wide variety of burial customs from which to choose (2009, p. 155).

[43] It is also possible that young children were purposefully killed without being sacrificed. Through the examination of birth records showing an inordinate number of male children in comparison to female children in historical periods when there were no ultrasounds to determine the sex of a child *prior* to birth, Demause has shown that even in Western Europe it is evident that many children were apparently killed through exposure and other means. This practice was a continuation of methods that had begun in ancient times that included "potting" chidren (placing them in pots to suffocate and perish), throwing them in ravines, putting them in the woods or other hostile climates where wild animals would often eat them, etc. Reasons for the practice could be to avoid the expense of raising them or any number of others. Female children were the most commonly killed in both more recent historical periods and ancient ones (Demause, 2005).

The discovery of these somewhat shocking secondary treatments that corroborate those of a century earlier are being debated currently and will continue to be the subject of upcoming studies for many years. At present, the suggested reasons for these burial treatments have included that at least part of Wainwright's initial argument was essentially correct; that these bodies are indicative of a ritual of dismemberment that was a precursor to the Osiris myth. Others note that only 5% of the graves were affected and therefore believe that these were people who had received capital punishment for crimes before their bodies were returned to their families. Since there is nothing extraordinary about the graves themselves in spite of the findings at Naqada, only the possibility that these bodies' treatment represents cases of human sacrifice has been ruled out by the principal investigators at Hierakonpolis for the time being ("The Workers' Cemetery-HK 43," n.d., para. 14).

Still, even these suppositions do not include all of the questions these findings have already raised. Dougherty asked the following in the same year as many of the discoveries: "Was dismemberment and defleshing one of the ways to prevent the corruption of the body—an alternative to costly resins and wrappings? Were they special members of society? Or were they social deviants who deserved nothing more than to (non-) exist in the afterlife defleshed and dismembered?" (2004, p. 12). Dougherty also believed that the wooden label of the early First Dynasty King Djer from Saqqara represented a possible defleshing of scalps for ritual purposes that could have explained the scalped heads from Hierakonpolis (p. 12). We might add this following question: given later Egyptians' concerns about being haunted or otherwise adversely affected by recently deceased family members in various Letters of the Dead and the many anthropological observations of this similar concern, could this be a way of incapacitating the deceased, in effect severing their ability to inflict harm upon the living?[44]

I believe that what is most significant to note here is that the secondary treatment took some effort. What is in dispute is whether or not it was a desirable treatment of the body. The burial practices at this time were quite different from those that appeared later in Egyptian history when Egyptians would perfect the construction of tombs and mummification. Implied within the suggestion that Wainwright first made was that this particular treatment of the skeleton of the body in Tomb 67 was a desirable one, in fact so desirable that it involved rites that would later be associated with kingship. If one looks at the other grave goods one begins to find similar associations. I believe that this impacts how we should view this particular grave and its iron.

There are numerous indications below that as iron made its first appearance in Egypt there were other changes taking place throughout the culture. Society was becoming increasingly complex and ultimately leading towards becoming the first state in history under a powerful kingship. Is it possible that Tomb 67 could contain some evidence for increasing social complexity? Tomb 67 contains symbols that were later

[44] Fifteen so-called "Letters to the Dead" addressed to recently deceased family members began to first be published in 1928 by Gardiner and Sethe. Most of the letters come from the Old Kingdom (c. 2543-2120 BCE) and First Intermediate Period (c. 2118-1980 BCE) although the Middle Kingdom (c. 1980-1760BCE) and New Kingdom (c. 1539-1077 BCE) are also represented suggesting the contents of the letters accurately portray long-lived, common beliefs. The majority of the letters were written on bowls with papyrus and linen being the other materials. ("Letters to the Dead," n.d.)

The deceased relatives mentioned in the Letters to the Dead were believed to have been able to affect many daily affairs including property rights, economic matters and health. A representative example is the Cairo Bowl from the Twelfth Dynasty (c. 1939-1760 BCE) wherein a widow reprimands her deceased husband in very strong terms for neglecting to keep a serving-maid from becoming ill. She demands that her husband fight for the maid's health against all of the people who are supernaturally causing her illness. (Gardiner & Seth, 1928, p. 7) incorporated into Egyptian kingship at the time of unification. Since these symbols are seen alongside the very earliest Egyptian iron they require further consideration.

Stevenson denies that there is evidence that Tomb 67 belonged to a chieftain or a young boy with extraordinarily high status since the size of the burial and number of contents did not greatly exceed any other (Stevenson, 2009). Nonetheless, the contents mirror some of the symbols of kingship found a century or two later on the Narmer Palette that many scholars believe preserves the record of the unification of Egypt as a king of Upper Egypt vanquished his Delta foes (see Appendix B, figures 8 &9). Grave 67 contains a slate palette that is formed in the shape of a fish. Similarly, King Narmer's name was represented in hieroglyphic form with a catfish and chisel on a ceremonial palette of a hard stone (greywacke) (Kemp, 1989, p. 39).[45] Other makeup palettes at the site of Gerzeh were clearly early forms that led to the final style that they would achieve by the time of unification (Stevenson, 2009, pp. 106-108).

Pear-shaped mace-heads as power symbols of early chiefs and kings. The white limestone, pear-shaped mace-head found in tomb 67 at el-Gerzeh is similar to the one that Narmer uses to smite his foe on the reverse of the "Narmer Palette" and that he holds in his hand opposite the crook and flail on the obverse side. The tomb also contains the only copper harpoon found at Gerzeh and the "Narmer Palette" contains several images of animals or people being gouged (Wainwright in Petrie et al., 1912, p. 16 & Appendix B, Figures 9 & 10). The pear-shaped mace-head is of special importance since the site of Hierakonpolis' Main Deposit included both inscribed and uninscribed versions

[45] The so-called "Narmer Palette" or Great Hierakonpolis Palette, Cairo Muesum, Cairo J.E. 14716, C.G. 32169).

dating from the Protodynastic era or First Dynasty, approximately 3150-2900 BCE. Joan Crowfoot Payne, the curator of the Ashmoleon museum, believed that the mace-heads were gathered from all of the local chiefs that had newly been conquered by the first unifiers of Egypt. She argued that depriving the chiefs of these emblems was intended to deny them their symbols of authority (In Hoffman, 1979, p. 302).

Hoffman contends that the Protodynastic mace-heads were "powerfacts that took on a loaded meaning in the throes of state formation around the time of Menes—one that became inextricably linked to the successful king's role as bold warrior" (1979, p. 303). He believes that their prominence emphasized the preference for interpersonal combat in which important people would engage in battle head-to-head, almost foreshadowing aristocratic Homeric battle. He also notes that the fact that kings ideally personally bashed their foes (also seen on the "Narmer Palette") suggests that physically touching an enemy was considered to be a matter of honor (p. 303).

My suggestion is *not* that the iron-bearing Tomb 67 bore a young man in line to be a chief, although the possibility cannot be ruled out altogether since we do not know what any of the superstructures of the graves appeared like, but rather that the objects in this tomb that were found in association with the greatest number of iron beads were both desirable and important enough that they were later included among the many symbols that came to signify Egyptian kingship. It cannot be known at this time if the young man was a warrior, admirer of warriors, a proud hunter/fisherman, a person with some shamanic or "specialist" knowledge, a young person with some other ascribed or achieved status, or some other option altogether. Nonetheless, I believe the overall assemblage provides us with the evidence for how to interpret this particular burial. Most of the contents from the bead necklace that included iron and gold, the mace-head, fish-shaped palette and copper harpoon were later valuable enough to be associated with the first kings of a unified state. I would conclude that in this case the burial treatment was a desirable outcome and that it indicated the interred had some power which needed to be either demonstrated or incapacitated. This leads us to the further inference that the iron was also a luxury or prestige good of some high value.

Having established as best as possible that iron was a prestige or luxury good known from two unique burials— one that Stevenson called a person with possible "specialist" knowledge and grave goods that came from faraway places and a second that had an unusual but not unknown burial treatment that I consider desirable in this instance— I would like to determine what iron's place was in the overall society. I will then proceed to establish why ironwork emerged at this time period. I would like to argue that ironwork emerged due to an overall increasing social complexity which was directly linked to their ability to either procure metals by trade, as I believe we can demonstrate that some of the surrounding polities possessed the necessary skills, or was due to growing indigenous metallurgical skills that were also predicated upon an increasingly sophisticated society. Either way, ironwork appears to emerge as part of a developing world with multiple power centers inside and outside Egypt in which objects that could socially enhance one's position would have value. Since we will see that little iron is used in this way in Egypt even though it could have been, I argue this indicates a cultural lack of preference for this particular material on their part which is not the case in all iron-producing cultures as we have already established in the previous section.

Iron Technology in the Predynastic: What Can Be said about the Producers?

What can we say about the iron producers in the Predynastic era? First, there is no specific record or direct proof of the trade of iron goods from this time period (Johnson et al., 2013, p. 998), nor is there any way of proving there was such a person as a professional iron-worker. There is simply not enough material evidence to justify such a conclusion. Nonetheless, we can demonstrate that considerable skill was required in order to produce the few objects known from this time period. While Johnson et al. argued that the iron beads from tomb 67 at el-Gerzeh were cold hammered (p. 997), there is another study that offers further specifics as we mentioned in the historical overview. Let us return to this evidence because it offers a view of the sophistication of the ironwork.

Iron bead production: hammered into sheets and rolled into shape. Thilo Rehren's team determined that the three beads they studied from the site must have been heat treated. They were formed by iron that was first hammered into sheets 1-2 mm thick and then rolled into tubular shapes. This team argues that annealing must have been part of the process, a practice that is known as early as the 9^{th} millennium BCE in Anatolia (Rehren et al., 2013, p. 4789). As we mentioned earlier, this would be an important revelation which these researchers emphasize would mean that 2,000 years before Egyptians began to smelt iron, they had already become well versed in the heat treatment of iron which would aid them in adopting the later smelting technology (p. 4785).

Regardless of whether or not these beads were only cold-hammered or heat treated as well, the extraordinary skill of those who worked this iron is evident from the intricacy of the processes involved in making them. To create beads with the resulting internal structure required beating them into thin sheets and then rolling them into an attractive shape proving that whoever created them were skilled metallurgists. We will see examples that there were such exceptional skills in Egypt at Tell el-Farkha in the upcoming sub-sections but we must always remember that they may have traded for the beads as well. Regarding their skill in ironwork it was either 1) transferrable from another technology such as gold or copperwork which have lower melting points, 2) imported from another land (either the products of the technology or the methods), or 3) part of a wider iron technology that did not survive in the archaeological record of the burials at el-Gerzeh. There is also the possibility that 4) the majority of iron was re-used (a practice known ethnographically from the Bantu, for instance) and therefore not included in cemetery settings. If the last possibility were the case we would expect to see iron at a site from the same era with more settlement data. In the next sub-sections we will explore all of these possibilities as we try to gain a deeper understanding of the Predynastic culture that gave rise to early ironwork.

Settlement Archaeology—Nagada IIC as an Era of Important New Domestic Architecture

One of the extreme difficulties that at first glance appears to frustrate our ability to understand the nature of iron production at the earliest stage in Egypt is that el-Gerzeh provides a cemetery with no settlement data, hence there is little context. Additionally, the Predynastic era was once the most poorly understood time period with regard to what its society, dwellings, possibility of craft specialization, rulers and long-distance trade were like. Fortunately, all of these issues are beginning to become illuminated by the enormous amount of new research being published by archaeologists who work at sites that have strata from this time period. At present very few publications summarize Predynastic and Protodynastic settlement architecture[46] widely across Egypt let alone areas on the periphery. Here we will undertake that project for the restricted period when iron appears, including a look at the borderlands and contemporary A-Group finds in Nubia. We will then look at the evidence for meteoric iron from Mesopotamia. What we will see is a widespread pattern that indicates clear evidence for social change in all of the areas enumerated above that would have influenced the iron producers of this time.

Tell el-Farkha

The earliest large settlement with complex mudbrick architecture in Egypt was actually found in the Delta—once considered archaeologically inaccessible— at Tell el-Farkha. It is home to the largest and best preserved Predynastic settlement which makes it extremely useful for our purposes (Chlodnicki, 2012, p. 13). It is also extraordinary for

[46] See Zdzeblowski, 2008 for a summary of the settlement archaeology of the entire era within the area restricted by the traditional boundaries of Egypt.

having three distinct cemeteries with burial remains that can be correlated to relevant settlement data. [Debowska-Ludwin, 2012, p. 75]

The site is composed of three *koms* (eastern, western and central) located in the eastern Nile Delta approximately 74 miles (120 km) northeast of Cairo (see map 6 above; "Tell el-Farkha," n.d.). The four hectare area was first excavated by an Italian team, then beginning in 1998 it was investigated by a Polish team led by Chlodnicki and Cialowicz. This team divided the western *kom* into five chronological phases, the first of which is roughly contemporary to the time period when the first known iron appeared in Egypt. This is the Naqada IIC-D1[47] period according to Kaiser or alternatively, Naqada IIC-IID1 according to Hendrickx, c. 3600-3300 BCE. What was found were round and oval pits (1.20-2.20 meters in diameter) that often impinged on each other with black fill and pottery sherds. These were believed to have been storage pits. Next to the pits were furrows arranged into a rectangular shape that may have formed structures, possibly houses, produced with organic materials. Altogether, the pottery finds and arrangement of the settlement are very similar to other Lower Egyptian sites including Buto (Cialowicz, 2003, pp. 130- 131). This area can now be said to have the best preserved Lower Egyptian settlement data (Chlodnicki, 2012, p. 13).

The central *kom* is the largest of the three, and its area which includes the earliest occupation at Tell el-Farkha covers half the site. Initial published reports indicated that it was the home of a specialized society from its earliest settlement. Craftspeople, farmers, fishermen and traders were believed to have been separated from the administrative center of the Western *kom*. It has now become clear that in the earliest, Lower Egyptian

[47] It may be as early as Naqada IIB.

settlement of Phase 1 this was not the case. The most important discoveries are that the same rectangular buildings whose remnants are the parallel furrows, mostly 10-15 cm wide, accompanied by oval pits sometimes lined with silt. In this area they were much better organized. There were also structures produced from solid silt called "mud-holes" or "mud-pits" that may have served to stabilize some of the post holes. The entire area was then divided into "zones" by walls made of wood or some other organic material. The western section was residential. The southeast portion had small houses and eventually a brewery (Chlodnicki & Geming, 2012, pp. 89-94). In its style, internal organization of buildings and overall planning the site is much more sophisticated than what has been discovered at Maadi or Buto (Cialowicz, 2012, p. 160).

The discoveries change at the end of "Phase 1" which corresponds to the Nagada IIC era to which the first known iron dates at el-Gerzeh. At this time the wooden fence is replaced with mudbrick walls 1.6 meters wide at the base and 1.2-1.3 meters wide at the top, substantial enough to be defensive walls in addition to dividing the zones from one another. This has been interpreted by some to be of great historical significance in that it may indicate that there was reason to fear conflict.

Important objects: mace-heads and metallic beads made of rolled sheets in a residential setting. There are a few objects of note for our purposes. Two pear shaped mace-heads were found, one of which bears a resemblance to the mace-head found at el-Gerzeh in association with iron. Twenty-seven beads were also found that appear to have come from Upper Egypt. They were made of agate, carnelian, rock crystal, quartz and amazonite. Importantly, four were gold beads made of thin sheets formed into barrel shapes. These are currently the first gold found in Lower Egypt and if the researchers' assumptions are correct they also indicate that Upper Egyptian goods were making their way northward. Unlike the beads at el-Gerzeh both the mace-heads and set of beads were found in a residential setting (Chlodnicki & Geming, 2012, pp. 95-98). From this evidence we can establish that the beads and mace-heads found at the cemetery at el-Gerzeh were indeed reflective of their importance in life.

The fact that no ironwork has been found so far is extremely telling. This site offers a residential example that confirms the rarity of iron in the mortuary settings. Iron appears no more important or deeply integrated into ancient Egyptian sociey in life than it was in death at present. In answering our research questions we can say the following: this finding makes it highly unlikely that iron production was a widespread technology, even moreso when we review the other metal objects that were found as we will in the section below. We must also note that the gold beads were formed in a similar fashion to the iron beads at el-Gerzeh. This gives us a clue that there would have been no need to import iron beads from outside Egypt since the skill set required to produce them was available from Upper Egypt, or alternatively from other Lower Egyptians if the beads were actually produced locally. It does not preclude the possibility that the iron beads were imported from outside Egypt (and one of the two burials with iron beads *did* have numerous objects noted for having come from afar) but it does demonstrate that the technical skills required to produce them were also available at or relatively near el-Gerzeh. Therefore, ironwork was a skill that could have been transferrable from other metallurgical skills indigenous to Egypt but we can say nothing further of the matter for now.

The Relationship Between Metallurgical Advances and State Formation

These findings allow us to ask one of the most important questions about ironwork at this time period. What was the relationship between the metallurgical advances that allowed for the production of the iron beads at el-Gerzeh and the processes of state formation? This has proved to be a particularly complicated set of questions for all research that dates to this time period. There are numerous schools of thought at present. The longest held theory comports with Stevenson's assessment of el-Gerzeh and aligns perfectly with the beliefs held by the primary researchers at el-Farkha. The Naqadians are believed to have come down the Nile equipped with various advances such as skills in pottery production and architectural construction as well as different burial practices. This was originally believed to have been a process of a literal conquest represented by the "Narmer Palette" where an Upper Egyptian proto-kingdom vanquished the Lower Egyptian peoples. Now some researchers argue that this was a much more complicated process[48] but the overall story of this interpretation remains the same: large movements of Naqadians heading northward were responsible for the creation of the first ancient Egyptian state (Zdzieblowski, 2008, p. 146). If so, this would make the first iron producers in Egypt among the conquering (or at least supplanting) Naqadians as they made their way north to new settlements including the one that created the cemetery at el-Gerzeh.

[48] Wengrow, 2006, pp. 88-89.

What would appear to corroborate this theory at Tell el-Farkha is the appearance of the new, more robust mudbrick walls that replaced the wooden walls which some find consistent with the idea that there was conflict between the proto-kingdoms. There was also new mudbrick architecture. In addition, the oldest burials at the site were dated to the Naqada IIIA2 and Naqada IIIB1 eras and appear to have been connected to a large mastaba (no. 10). According to Debowska-Ludwin the early creators of the cemetery later fled and were replaced by another Naqada community that created an Early Dynastic cemetery (Debowska-Ludwin, 2012, pp. 73-74). For our purposes what is useful is that this gives us the opportunity to see how tools were treated during the Predynastic era. There were 38 copper objects found at Tell el-Farkha including tools such as adzes, axes, awls, chisels, fish hooks, harpoons, knives and pins. Decorative objects included bracelets and earrings and then some indeterminate globules that may have been slag were discovered. [Czarnowicz, 2012, pp. 345-354]

There are other indicators that Tell el-Farkha was well on its way to becoming an important proto-kingdom including its advances in metallurgy. Among the spectacular finds at the site are two golden figurines of a Predyastic ruler. The statuettes are standing nude males sized 60 and 30 cm tall from the Naqada IIIB period. Both were metal shaped over a missing core, more than likely wood. These figures are bald, shaved and required separate sheets to produce attached ears and penis sheaths. The sheets of gold were very thin and fastened by golden rivets, both of which show the high degree of skill of the metallurgists of this time (Cialowicz, 2012, pp. 201-205). Once again we see that the skill to produce thin sheets of metal (the same skill required to produce the first iron beads) was a feature at this Naqada era site. In addition, the fact that their skills were available to the ruler is evident as is the probability that their social organization was moving towards a more complex chiefdom. Note that gold was already associated with an apparent leader, iron was not in any way we can determine in spite of the eventual references linking iron to the gods, heaven and king. The investigators of the site believe that Tell el-Farkha had become one of the most important—perhaps *the* most important—settlement in the Eastern Delta (p. 106).

Therefore, copper was used for common objects, gold to depict the leader, iron is completely absent. As for the interpretation of the evidence, some view the evidence for the cultural unification of Egypt completely differently. A second idea about how it occurred is represented by Köhler who argues that Upper and Lower Egypt developed gradually from within. She argues that each region was influenced by its own geography, contacts with other regions and ecology. Zdzieblowski looks at the evidence of numerous sites including Tell el-Farkha and argues that one important advance, mudbrick architecture, actually spread from Lower Egypt in the north to the southern Upper Egyptian Naqada culture. The chronology outlined above could certainly fit this opposite interpretation although none of the primary investigators at Tell el-Farkha sees it that way. Finally, Watrin believes that the Ma'adi site was influenced by the arrival of Palestinians who brought their advanced skills in metallurgy as well as stone and brick architecture. [Zdzieblowski, 2008, pp. 147-148)]

Therefore, we can argue that in the 4th millennium BCE, Lower Egypt was clearly making societal advances in architecture and other facets of life much earlier than once believed, they were in contact with faraway cultures, such as those of the ancient Near East, and they were producing the first metallurgy to be found in Egypt. In this sub-section we will explore these issues.

Watrin's reasons for asserting the primacy of Ma'adi include that it produced the very first known examples of Egyptian metallurgy and first Egyptian stone architecture. Ma'adi's importance predates the other Lower Egyptian settlements we have explored so far, in fact it is the only village from the fourth millennium BCE that is completely preserved.[49] In addition to habitation areas the site has three necropolises all of which date to Naqada Ic-IIa, c. 3800-3500 BCE, or a few centuries before the appearance of iron. In the most recent levels there are "copper drops" which appear to be remnants of metallurgical processes. Watrin is quite insistant that it is no coincidence that the same site has Palestinian ceramics. In his view, Egyptian metallurgy originated in Lower Egypt and was an import that came by way of Palestine during the EB Ia1 phase. [Watrin, 2000 pp. 163-170; see Appendix E for a comparitive chronology between the Levant and Egypt]

In the following sections we will look at Palestine, Nubia and Mesopotamia to see the nature of the evidence for iron production in these time periods. In the case of Palestine we will need to look to a period prior to the arrival of iron, for Nubia there is no iron to investigate for this time period so we will look to significant finds that impact our study that roughly correlate to the Predynastic era and for Mesopotamia we will be able to investigate the sole example of a literate society's extensive treatment of meteorites

[49] Buto is also preserved, but its remains lie under seven meters of sediment and therefore have been excavated via trench soundings (Watrin, 2000, p. 167).

and meteoric iron. What we will see is that Egypt was not alone in creating proto-states and other societal advances as metallurgical skill was also on the rise. We will also be able to investigate some ideas for how Egypt became an iron producer.

Palestine[50]: Early Technical Success in Metallurgy at Same Time as Social Advances

If Palestine is to seriously be considered as an origin point for the Predynastic Egyptian metallurgy, we need to look closely at the nature of the finds. Palestinian metallurgy is very intriguing for it mirrors some aspects of the way technological advances occurred in Egypt—a manner which may appear *regressive* at first glance. Egypt has sometimes been argued to have had an early period of experimentation and remarkable technical success in many areas that culminated at the *begininning* of its history with such advances as the production of the Old Kingdom's Great Pyramids (beginning with a predecessor's step pyramid under King Djoser who reigned from c. 2780-2761 BCE) only then to have been followed by a long, slow decline.[51] This is certainly an oversimplification of the evidence and one that can be argued against, for example temple building is believed by most scholars to have achieved its greatest form in the New Kingdom (c. 1539-1077 BCE) and many of the king's efforts were transferred to this new arena.[52] Nonetheless, this pattern appears to be somewhat similar to Palestinian metallurgy which gives credence to the idea that technological advances can occur in this direction. In the Levant the most significant metallurgical advances appear

[50] In this dissertation I use the terms Palestine and the Levant interchangeably without intending any political implications for either term. I generally follow the lead of the particular scholar I am quoting at the time although there are exceptions.

[51] Knapp, 1988.

[52] Wilkinson, 2000.

to have occurred at the *beginning* of their history in the fourth millennium. After 3,000 BCE they were no longer at the forefront of technological change in this area, the greatest metallurgical progress began to occur to their north at the most significant sites of modern day Syria including Ugarit, Ebla, Mari and Emar (Richard, 2003, pp. 174-176).

The nature of the evidence for early Palestinian metallurgy comes from the hoards and *dépôts des offrandes*, votive caches believed to have been associated with temples in which as many as several hundred pieces of copper valuables were tucked away for safe keeping. The most important of the hoards is the earliest, that of Nahal Mishmar discovered in 1961. This cache came from a high perch at a Dead Sea cave located 650 feet up the side of the wadi and contained 429 objects of which all but thirteen were produced of copper. There were ten circular objects deemed "crowns" although their true purpose is unknown, flat axes, adzes, scepters and standards. It is perhaps significant that there were 240 copper mace-heads, most of which were spherical or pear-shaped and six other mace-heads of hematite and one of limestone. Given the importance of mace-heads in Egyptian history in kingship, caches and burials one wonders at their function here. [Moorey, 1988, pp. 171-181]

Unfortunately, the true purpose of the hoard cannot be determined at present. Ussishkin believes it belonged to the Chalcolithic temple he excavated at En-Gedi that has some objects reminiscent of some of the collection but Moorey argued that it was best viewed as the treasury for a community that had to leave quickly (1988, p. 182). The reed mat in which the objects were wrapped dates to approximately 3500 BCE which scholars note is a highly significant time period. This was an era when there were enormous advances that were occurring in the region in the areas of food production and social development. Farmers were just beginning to produce olives and dates while herders began producing milk products. In addition there were clear changes in the social complexity across the Levant: elites were able to marshal the services of artisans to produce wall paintings, terracotta figurines, sculptures and ivories. ["The Nahal Mishmar Treasure," 2004, Department of Near Eastern Art] Notice that every time we see growing skills in metallurgy we see the accompaniment of social advances in numerous facets of life. In my view, this is indicative that the two are quite intertwined and explain the Egyptian evidence as well. In particular, it appears that metallurgy was not merely technologically useful but had sociological value as well in that it was capable of enhancing one's status. In effect, even the quintessential metal of "utility," iron, was actually a prestige good as well which was not unusual for metal objects.

Prestige Objects: Include Copper Sheets, Similar to Egyptian Metal Bead Making

The prestige objects deserve our attention. While they were once thought to have been produced of arsenical copper it has now become clear that they were actually a unique three part alloy comprised of arsenic, copper and antimony, with the antimony appearing in quantities up to 20%. The Kfar Monash hoard is most important with respect to the Egyptian Predynastic era for it corresponds to the EB1 strata, roughly dating to the same time period (See Appendix E for comparative dates). Among these objects were small, thin sheets of copper. It was once suggested that they were scales for armor but now it can only be said that this is unlikely and the copper sheets were used for unknown purposes (Richard, 2003, p. 174). This is especially significant because it is so similar to the skill set required to produce the Predynastic Egyptian beads.

Altogether the Levant was an area with a thriving and sophisticated population with significant social complexity that was producing metal objects with a technology that *could* have been imported to Egypt by way of the Delta at Maadi (in copper) and later transferred to iron production. Nothing more than the possibility exists so until there is more definitive proof this is where we must leave this end of the story. Now let us turn to a region that was in clear contact with the iron bead producing Naqada culture from the opposite direction but was most famous for its gold production at this early date.

Nubia: A-Group Culture

By 3500 BCE Lower Nubia was inhabited by a people known as the A-Group who were the primary trading partner of the Upper Egyptian Naqada culture. For instance Cemetery 298, excavated by a Scandinavian team found 50% of the graves had Egyptian imports (O'Connor, 1993, p. 19). These same people had almost no contact with the Maadi culture further to the north. Unlike other Nubian cultures that were pastoralists or hunters and gatherers, A-Group inhabitants were sedentary agriculturalists who may have lived in communities with 20-25,000 people, much lower populations than the 100-150,000 people believed to have lived in Upper Egypt at the time (pp. 12-15).

In contrast to the people of the region we will view in the next sub-section, the A-Group culture did not appear to use iron but the small and rare amounts of metal they did employ appear to have been imported (p. 15). In spite of the fact that their culture was in close contact with the Naqada culture they do not seem to have been significantly influenced by them. This offers us an important perspective because some facets of their society were similar to the contemporaneous Egyptian culture. This is significant for establishing a wide, interregional pattern: it suggests that the time period contemporary with the late Egyptian Predynastic era at the end of the fourth millennium BCE was one where there were many growing polities with increasing complexity within *and* outside the boundaries of Egypt.

The A-Group cemeteries that have been excavated are all in the low desert along the floodplain. It has been argued that later A-Group communities were mudbrick structures fortified by town walls on the basis of the Egyptian example although this has yet to materialize archaeologically (p. 15). Two of the best excavated and recorded cemeteries from one community, 277 and 401 in southern Lower Nubia produced 66 and 33 graves respectively over a 150-200 year period. In both cases they had elite burials. The Classic A-Group graves were quite large, averaging 3.54 meters (pp. 16-17). Cemetery 277 in particular has graves that demonstrate there were elites in control of the resources. Grave 34 contanined a necklace with 46 gold beads and the second large grave, no. 37, contained two copper awls which were Egyptian imports (p. 18).

There are numerous indicators that Nubian society had reached a state of considerable complexity at this early date. The three largest graves, the aforementioned number 34, 37 and 27 were all female burials with the exception of one secondary male burial that seemed to have a higher status than the political leaders. They are likely to have achieved some hereditary rule for there were A-Group burials of children that had elite status with grave goods that included ostrich eggs, perhaps to symbolize their rebirth in the next life or some other purpose. In addition there were three male burials on some of the highest ground at the cemetery who were wrapped in hides and given ostrich feather fans (p. 18).

The cemetery L near the village of Qustul dating to the Terminal A-Group is so elite that it has been argued that it indicates that Qustul was a royal capital. There were only twenty-three large graves, sixty per cent of which had trench-like pits with subterranean chambers. There were a high number of imported Egyptian goods including 271 examples of pottery. Nubian style cosmetic palettes were found made of semi precious stone including amethyst, milky quartz and rose quartz (p. 20).

The cemetery was argued to have been the earliest pharaonic style cemetery in the Nile Valley by Bruce Williams. He believes the individuals interred in cemetery L controlled Lower Nubia and then conquered southern Egypt. O'Connor argues this is unlikely because the primary reason Williams' hypothesis was a possibility was the fact that the graves antedated the earliest Egyptian kings of the Naqada IIIB phase. As soon as a royal tomb dating to the Naqada IIIA phase was found his theory was deemed to be unlikely (pp. 20-21, see Appendix E for approximate dates for Naqada III era).

In O'Connor's assessment this cemetery's occupants were important, nonetheless, they seem to have belonged to a complex chiefdom whose rulers controlled all of Lower Nubia. Their status appears to have been high enough to call this a proto-kingdom and its rulers kings (pp. 21-22). We can state rather confidently that they were likely to have been in the process of achieving a social complexity comparable to Egypt at this time.

What is significant for this study is that an elite grave, 137, contained two maces that were sheathed in gold, one of which was also decorated with a row of animals. O'Connor argues that these maces were "symbols of kingly power imported from Egypt" (p. 22). Seeing this it is all the more suggestive that the mace-heads found with the iron in Predynastic Egypt were important. Again, it cannot be assumed the iron was found with chiefs, proto-kings or kings but a look at the wider region of the environs around Egypt suggests that the iron was found in association with grave goods that did have symbolic import in many societies. Whether the mace-head found with iron in Egypt was a "powerfact" as Hoffman called it or simply a high status good as it appears among these many other Egyptian and foreign societies, it was more than likely a signficant item. Again, this corroborates the idea that the iron contained within the Gerzeh burial was a luxury or prestige good found with other luxury and prestige goods.

In the next sub-section, we will see a contemporary population that wrote extensively about meteorites, understood their relationship to iron and yet offers a very powerful caveat about how iron might have been regarded in Egypt. It may be difficult to determine what the Egyptians thought of iron at the earliest point in their history but we do know much about what one nearby, highly influential culture believed.

Meteoric Iron in the Ancient Near East: Important but Not Worshipped

There is one area in the region that has an entire body of modern scholarship devoted to meteors including some work about meteoric iron: Mesopotamian scholarship. The cultures that lived in the ancient region of Mesopotamia were unique in that they observed and wrote about meteors extensively because the inhabitants believed meteors offered special messages from the gods. Between 3,000 and 2,000 BCE the word *kakkabu*, or “star,” evolved into the cuneiform MUL-sign as follows. Its meaning was extended to indicate meteors and was also a determinative used in front of specific names of stars (Bjorkman, 1973, p. 94).

This linguistic phenomenon is not entirely unknown in Egypt. The sign for star or a class of stars may have been extended to mean meteorite in Egypt as well. We alluded to this argument in the historical section when we discussed Wainwright’s theories but we can state it more fully here. The classic Twelfth Dynasty (c. 1939-1760 BCE) tale of the *Shipwrecked Sailor* mentioned an object called a *sšd* spelled with a star-sign determinative (see below) that fell from the sky onto an invisible island and burned up 75 serpents—the brothers, sisters and companions of another talking serpent. It has been suggested that the object that fell from the sky was actually a meteorite with magical properties. [Wainwright, 1932, p. 8; Simpson, 2003, p. 51]

In Mesopotamia, however, the situation is much clearer than Egypt. There was an extensive literature that described meteors as omens. In the second millennium approximately 7,000 texts regarding celestial events were compiled into a body of works called the *Enuma Anu Enlil*, meaning “When Anu and Enlil …” which refers to the first phrase of the collection. Each of the texts is organized into two parts: the protasis or “case” which is usually the sighting of a meteor and the apodosis or “consequence” i.e. what will happen in the event of the sighting. [Bjorkman, 1973, p. 93]

The attributes of the celestial events were considered indicative of what events would pass so the specificity was remarkable. The celestial events that were recorded fit the descriptions of meteors, bolides (meteors with associated sounds and/or smells), fireballs (meteors of extreme brilliance or duration and smoky or fiery trains) and faint meteors all of whose directionality along the horizon or from east to west, or west to east were often provided (p. 95). The apodosis could refer to common individuals, but in most cases the meteor sightings were expected to have very important political ramifications such as determining the outcome of invasions, rebellions, battles, usurpers to the throne and even prognostocating the deaths of important individuals. For instance, the following: “[When a mete]or flashes from the south and comes close (to) and (then) disappears (in) the ‘station of Anu,’ and its … are yellow (or, green) a great king will die” (p. 96).

The Mesopotamians were aware that stones, “stars” and iron could all fall from the sky although it does not appear that they were aware these were the products of bolides (p. 94). There is very little *direct* evidence for their understanding of the celestial origins of meteoric iron but it does exist. In particular, there is a Hittite text that clearly states the following: “The diorite they brought from the earth. The black iron of heaven they brought down from heaven. Copper (and) bronze they brought from Mount Taggata in Alasiya (Cyprus)” (p. 110). In 1800 BCE an Old Babylonian hymn included the following phrase “the fall of iron to the ground” (p. 113).

In addition, there is circumstantial evidence provided in the Epic of Gilgamesh. The 17th century BCE Old Babylonian version describes a dream that Gilgamesh has and tells his mother, the goddess Ninsun:

> The stars appeared in the heavens.
> The *kiṣru* of Anu descended towards me.
> I sought to lift it, it was too heavy for me!
> I sought to move it; move it I could not!
> Uruk-land was gathered about it,
> While the nobles kissed its feet.
> As I set my forehead,
> They gave me support.
> I raised it and brought it to thee. [Bjorkman, 1973, p. 116]

The *kiṣru* of Anu has been proposed to indicate an iron meteorite although the material of which it is made is not explicit. In this case it is a typical dream omen which foretells of the arrival of a friend who will be the match of the king Gilgamesh, the famous companion Enkidu with whom he will share many adventures (p. 116).

In spite of all of these 1) direct and indirect descriptions of meteors and meteorites, 2) beliefs of various Mesopotamian cultures that meteors provided extremely important messages about the future from the gods and 3) their understanding that meteoric iron came from the heavens, Bjorkman found that they never made iron the subject of any particular rituals. Meteoric iron was never held in awe nor fear, it was simply seen as another natural substance (p. 95). Therefore, when we see that the Egyptians understood that iron came from the heavens by at least the 19th Dynasty if not much earlier—perhaps even in the Predynastic era in the fourth millennium—we should still understand that the Mesopotamian examples suggest this does not necessarily mean that they held it in any higher regard than any other precious stone or metal. This is an extremely important caveat, in my view as it is all too tempting to attach great symbolic import to “heavenly” substances. Likewise, we should remember that even though there is linguistic evidence linking iron to the heavens by perhaps the First Intermediate Period (c. 2118-1980 BCE) in Egypt, the Egyptians did use the same word to merely indicate the sky. Yes, the sky was the realm of the gods but so was every other domain of life. The Nile, cultivation, houses, and even air, the sun and moisture were equally linked to gods. In any event, all evidence at present suggests that iron was not integral to most of the ancient Egyptians’ rituals, culture, lifeways, agriculture, workmanship, symbology, cosmology or any major overarching facet of life in the Predynastic era (c. 4,000-3,000 BCE).[53] It was, however, a small part of the emerging metallurgical skills that accompanied a great deal of increasing social complexity across Egypt and surrounding regions at this time. The fact that iron was capable of enhancing social prestige but evidently was rarely chosen to do so, in my opinion, indicates the Egyptians were not highly focused on iron to the same degree other metals or stones filled their needs.

Conclusions for the Predynastic Era

The iron beads produced from Tell el-Gerzeh were part of two unique burials. The interred individuals do not appear extraordinary enough to have been chiefs or other rulers but the contents of the graves and the manners of burial suggest they could have been ritual specialists or other persons of some note. When we look at our research questions we see that viewing the settlement data in association with burials at Tell el-Farkha or other cemeteries like Hierakonpolis, we find no further evidence for ironwork. Alternatively, there is a lot of copperwork and significant thin sheets of gold from Tell el-

[53] Dating of chronological era from Midant-Reynes, 1992, chapter 7)

Farkha as well as thin copper sheets from Palestine, the so-called “scales of armor” that were not likely to have been used for that purpose but describe their appearance so colorfully.

This suggests that 1) Predynastic ironwork could have been a technology that was transferrable from gold or copperwork 2) its absence at Tell el-Farkha and Hierakonpolis (and the earlier site of Ma’adi) indicates it was not widely used or employed for tool making at this time. 3) We also find that ironworking may or may not have been a technology imported from a foreign land at this early date, but it is important that it is entirely possible that a preceeding metallurgical skill was imported and transferred to ironwork with skills from copper and gold production being among the most likely. 4) It is highly unlikely that iron tools were simply kept in use so much that they were not recovered in the cemetery setting because Tell el-Farkha’s numerous copper tools were recovered from residential settings without any iron examples.

This leaves us with the likelihood that meteoric iron was rare in the Predynastic era (c. 4,000-3,000 BCE) and used primarily for luxury goods, or at Stage 1 in Snodgrass’s tripartite scheme. When we look to the significance of the social advancements that were occurring at the time we see that everywhere metallurgical skills were becoming advanced there were significant changes in the social sphere. At Tell el-Farkha, Nubia and Palestine there were some or all of the following: developing proto-kingdoms, chieftains, new forms of food production, specialized craftspeople (sometimes in service of the elite or temples), more formidable walls and new types of domestic and urban architecture.

We know that the Egyptians eventually understood that iron could arrive from the heavens and that by the Old Kingdom (c. 2543-2120 BCE) they believed that it was significant to kings and gods being used in their weaponry, the vault and doors of the heavens and heavenly palaces. It was the substance the bones of the king turned into after his apotheosis, among other great purposes. Iron was used for ritual implements for the Opening of the Mouth ceremony which had great import. We can state that it appears to have been a luxury good and that it can convincingly be argued to have been significant as a good that represented some sort of symbolic specialist-level knowledge. It is my contention that the ambiguous burial treatment of the second interment that contained iron was more than likely positive because of the evidence we amassed about the other objects contained within the burial as well as the general characteristics of the time period which included increasing social complexity. The palettes, mace-heads and importantly for this argument, the iron, probably accompanied a desirable burial.

Equally important is the fact that we found that iron was missing from the residential settings at the same time. Iron at this early date was desirable but in no way integral to ancient Egyptian society. Why not? They had the requisite skills to produce more iron goods and a society that was growing in complexity. Luxury goods with apparent prestige value could have conferred status on their owners. Since the symbolic import of it being a "heavenly" substance is also unknown, the Mesopotamian example is quite crucial.

The way iron was regarded in Mesopotamia where there was an ancient body of thousands of texts that included references to meteors and meteoric iron is instructive.

There iron was seen as the product of something that offered messages from the gods yet it was still not used for ritual purposes, nor regarded as particularly magical. Likewise, in spite of iron's heavenly origins there is no evidence it had day-to-day significance for the average ancient Egyptian either. I contend that in spite of the fact that the ancient Egyptians were clearly skilled metallurgists in their own right, it was actually the instigation of outside forces that would change Egypt's relationship to the metal and even then it would not be integrated into the society to the same degree we saw with cultures like the Bantu or Greeks. In the following two sections we will begin to see these changes as they affect Egyptian history and the trajectory of iron use there.

The Late Bronze Age

Summary: During the Bronze Age (c. 3,000-1200 BCE) in the ancient Near East great kingships were at the apex of their power and interacted with one another in a system of exchange and diplomatic relations that were very ordered and status-oriented. Small amounts of iron in the form of prestige goods made their way along this network and iron production was occasionally mentioned in letters and texts, all of which suggest that iron was probably produced in a patron-client system.

The cataclysmic destruction that resulted in the Bronze Age Collapse c. 1200 BCE saw the entire region change at every level. There were massive movements of people, the end of most of the governmental structures of the former great polities and dozens of sites that were completely destroyed. In this section I argue that the fact that Egypt survived with much of its overall societal structure in tact actually prevented it from entering into the Iron Age at this time. Presumably iron production remained in the service of small segments of the society. Other parts of the ancient Near East changed as iron producers no longer had the same great kings for clients. Suddenly there were more farmers, migrants, raiders and greater numbers of exchange networks for ironworkers to create their goods. The massive societal change and new uses for iron are the likely reasons for the increased frequency of iron's appearance and its new forms: in effect, these great societal changes are the reason for the beginning of the Iron Age.

The World War I of the Ancient World: The Late Bronze Age Collapse as a Time of Great Transitions, Cataclysms and the Beginning of the "Age of Iron"

How was iron viewed during the time period when it came to be used more frequently? As we established in the historical section, iron use first underwent a change in Egypt during the 6th century BCE at the site of Naukratis where an industrial sector can be identified and there was an uptick in iron production at a few sites like it and Tell Defenneh. In the following section we noted that this transitional period occurred much earlier, around approximately 1200 BCE, in other areas of the ancient Near East and Mediterranean. It is my contention that underlying social factors and the manner in which Egypt viewed iron prevented Egypt from engaging in industrial iron production in the intervening six centuries. Even the 6th century BCE would not see a fully developed Iron Age. As stated earlier, I argue that the chronology of the Egyptian Iron Age should be seen to peak in the Roman era (c. 30 BC-395 CE) and even then may have been a relatively modest phenomenon. What was the reason behind all of these delays? Why was the adoption of industrial iron production in Egypt such a halting affair?

In this section we will look at the textual evidence which I would argue demonstrates that in the Late Bronze Age iron was a high value good that was relatively rare—even perhaps among other societies once thought to have had great iron stores. At this time, we will see iron's prestige value appears on the international circuit along the exchange network of the Great Kings. The fact that iron becomes an exchange good that was valuable (but not crucial) to the royal household may have been an indigenous development, but was surely enhanced by its importance on the international stage. After all, we will note we do not see it appearing much beyond the royal/temple sphere.

If we inspect the evidence closer I believe we do see clues that the ancient Egyptians were capable of using iron for more practical purposes that presages the fact that they would do so in later centuries. Nonetheless, in spite of the fact that the ancient Egyptians were likely to have had the ability to become greater iron producers during the Late Bronze Age-Iron Age transition of 1200 BCE they did not while many of their neighbors did. I attribute this to the strength and resilience of ancient Egyptian social institutions in the face of calamities that shook the rest of the region.

The Collapse Theories

There is little that did *not* change at the end of the Late Bronze Age in the period directly prior to the "Age of Iron." Massive re-alignments in the political landscape were met with what appear to have been food shortages and movements of masses of people driven to relocate because of war and/or raiding in addition to some other possible ecological events.[54] These cataclysms are so far reaching in their destruction of so great a

[54] The literature about the Bronze Age collapse is extensive, growing and often contradictory.

number of world empires and important coastal city-states that we might easily collectively label these events "the World War I of the ancient world." During World War I numerous large empires fell only to be replaced by a new world order dominated by smaller nation-states and many changes occurred in all facets of society from beliefs, to new forms of weapons and warfare to changes in gender relations (Dunn & Mitchell, 2015, pp. 714-725). A similarly world-altering set of circumstances happened millennia earlier during the Bronze Age Collapse around 1200 BCE.

An astronomical number of sites, forty-seven[55] altogether from all around the Eastern Mediterranean were razed to the ground demonstrating that warfare and/or raiding on a massive scale was at least part of the circumstances that led to the chaos that reigned for centuries. The world empire of Egypt became less active in international affairs for a millennium and the palace-centered societies of Bronze Age, Mycenaean Greece disappeared and entered into their centuries long "Dark Ages" when even their literacy and the high culture represented by Helladic pottery became reduced to mere memories preserved in their many myths and legends. Anatolia's Hittite empire was

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The overall theories proposed for the causes behind the collapse have ranged from the idea that raiders, climate events, geological activity or a system collapse were responsible to the less widely accepted theory that the smallpox virus (Slattery, 2000) was the ultimate reason. Books and articles cover many aspects of this period that occurred at approximately 1200 BCE including Neumann (1985) who argues that a drought that Aristotle wrote about in Mycenae occurred around this date (pp. 441-447). Others write about massive population movements like Mierse (2012) who briefly describes the in-migration of Mesopotamians and Aegeans into the Levant shortly after the same time many cities were destroyed there (p. 31) and also writes more broadly about the Levant during this era and the recovery afterward.

Popular books have discussed the subject of the "Sea Peoples" who created havoc across the region like D'Amato and Salimbeti (2015) or described them in a more scholarly synthesis like Sandars (1985). There are works that cover this period from the point of view of single cultures such as Middleton (2010) who writes about the end of the palatial period of Greece or other authors who write more broadly about the general destruction and collapse across the entire region like Drews (1993), Robbins (2001) and Cline (2015).

[55] Two sites Miletus in Anatolia and Carchemish in Syria are in question, nonetheless somewhere between forty-five and forty-seven sites were destroyed by fire circa 1200 BCE (Drews, 1993, p. 9).

reduced to slag and ashes, and the main sites of Cyprus, Crete, Syria and the Levant were burned to the ground. [Drews, 1993, p. 3 & pp. 8-9]

While the name of the age comes from the momentous shift from bronze as the main metal for weapons and tools to that of iron, a subject to which we will return momentarily, the other changes were just as important. The substrate of the society was forever altered as spirituality changed. In the Levant the most significant shift was a growth of monotheism whereas Egypt continued its millennia long-term trend as polytheists. For the average person the relationship between themselves and their god-king had been redefined as an explosion in popular religion allowed pilgrims to visit temples. In this new world of the 1st millennium BCE, the average person could be expected to enjoy a resurrected afterlife once reserved for royalty alone, a trend that had begun by at least the Middle Kingdom if not well prior. Scholars have dubbed this the "democratization" of religion.[56] Nonetheless, widespread corruption on the part of the priests and a diminution of the pharaoh also appear to be a part of the story. This belies a contradiction. In spite of the disappearance of literacy among the Mycenaean civilization

[56] Like so many other aspects of ancient history (and this time period in particular which is especially rife with varying interpretations), this much cited change in religious beliefs that scholars such as Rosalie David, James Henry Breasted, Kurt Sethe and Alan Gardiner contributed to popularizing may be erroneous (Hays, pp. 116-117). The general idea is that the afterlife was once reserved for the pharaoh alone in the Old Kingdom (c. 2543-2120 BCE) but that became increasingly open to the general populace as the king's power diminished. Prominent scholars including Harold Hays and Mark Smith argue that no such "democratization" occurred. Phrases that helped one achieve the afterlife were found in association with non-royal burials like the shroud belonging to a provincial governor named Medunefer generally dated to the 6th Dynasty (c. 2305-2118 BCE) of the Old Kingdom (Smith, 2009, p.2) quite early in Egyptian history. Early tombs also display indirect evidence of lector priests reading spells to glorify non-royal individuals in the afterlife (p. 3).

Furthermore, early in Egyptian history a non-royal person could become an *akh* which was a spirit that consorted with the gods (p. 3). Smith believes that the so called "democratization" was simply a change in practice where spells to achieve the afterlife were more commonly displayed in later periods for reasons that are still unknown (p. 4). At present the idea of the democratization of religion is still employed by scholars but will probably become modified.

there was eventually a proliferation of alphabetic writing in the Eastern Mediterranean that can be called *both* a simplification and possibly an advance over the previous cuneiform script. Further changes included an archaizing form of nationalism, representative government in Classical Greece and the origins of rational, scientific thought also burgeoned throughout the region (Drews, 1993, p. 3 & Myśliwiec, 2000 [1993], pp. 15-20). While the chaos and end of the "golden ages" and previous heights of great empires were altered and in some cases came to a close there was a modernizing effect as well, again, a situation akin to the transformations that occurred after World War I or other cataclysmic times of change like the "Fall" of the Roman Empire.

One can divide the theories about *why* these major transitions occurred at the end of the Bronze Age/beginning of Iron Age in 1200 BCE in terms of those who believe some outside, environmental factor(s) were the primary causes and those who see human actors being the deciding cause. In May 1990 the historian W.W. Hallo's opening remarks put the two opposing camps in these stark terms:

> I thus reject all field theories that threaten to obscure the boundaries between natural history and human history… The traditional hypotheses for explaining the crisis of the 12th century B.C.E are mostly concerned with natural disasters such as earthquakes, famine, or climatic change. But all of these rest on the chance recording of what are basically perennial factors. The transition from the Bronze Age to Iron Age should be seen rather in terms of the human role. [In Issar & Zohar, 2007, p. xxv]

In this section I will further the argument that iron metallurgy on such a scale was affected by the connections between polities, in essence that the "human role," i.e. societal changes were the integral factors. In effect, I take the position of those systems collapse theorists who believe that the web of relations across the region had become so complicated that a grave problem in one area – such as climate change or a natural disaster – was bound to reach the doorsteps of the other great powers through warfare, raiding or resettlement of dislocated peoples. In the section that follows we find evidence that the human form in which these cataclysms were delivered appears to have been through bands of raiders. Why they were raiding becomes the remaining mystery. In a following section we will get a picture of the scale of the devastation and the locations of the sites affected at each geographical area around the Eastern Mediterranean. Each tells us something of what occurred that paints the scene of a wholly re-ordered new patchwork of changed or fallen polities that is massive in its scale. But first, let us describe the nature of the Late Bronze Age production of iron in Egypt and the conditions under which it was produced.

Bronze Age Iron in Egypt

We are fortunate enough to have some literary references to iron preserved in the letters that circulated among the "Great Kings" of the ancient Near East who were part of a system of gift exchange, intermarriage and international diplomacy that benefited them mutually but was marked by rivalry and attempts to out-maneuver one another as well. In the case of the most important documents like treaties some were actually inscribed on a more permanent form like wood or metal including iron, silver or bronze (Bryce, 2003).

The gift exchange that circulated among the five great kingdoms of Assyria, Babylon, Hatti, Mittani and Egypt were occasions for the rulers to celebrate important events and demonstrate their largesse and prestige. Gold was the most prominent metal associated with Egypt and a clear representative of the pharaoh's wealth but the inventory lists do mention iron as well. This is significant because when objects and the material of which they were made were itemized in the letters that accompanied the gifts sent from one royal house to another it was presumably so that none would be purloined. When the messenger arrived it was probably with great fanfare: a reception replete with high dignitaries and other officials. The reading of the inventory and presentation of gifts would more than likely have been conducted as an ornate ritual in itself (Bryce, 2003). Therefore, when one sees iron appear on such inventory lists it is an indication that it was a high value good great enough that it could inspire awe even when given from one of the greatest kings of their age to another.

On the occasion of the marriage of the Eighteenth Dynasty ruler Amenhotep III (r. 1390-1353) to the daughter of Tushratta, the king of the Mittani, the latter sent magnificent gifts that took four sections and 49 lines just to describe and included chariots, horses, bridles, bronze and gold vessels, shoes, garments, necklaces and more. Among these iron was included for this particularly important, conspicuous gift-giving display. Two of the objects could be called "prestige daggers" in the parlance of Snodgrass, listed as "[1] dagger, the blade of which is i[r]on, its guard, of gold, with designs" and the other was also bimetallic with precious stones, "1 dagger, the blade of which is iron; the haft has an inlay of…-st[one]; its…, mounted on gold." Another weapon that was probably ceremonial was a mace made of iron and overlaid with gold. Then there were the pieces of jewelry: two hand-bracelets of iron overlaid with gold and inlaid with lapis lazuli bird motifs were included. To round out the list there were ten javelins with iron tips. [*The Amarna Letters*, EA 22]

The javelins could have been objects of "utility" in Snodgrass's scheme but we must remember that they were also prestige goods in this particular gift-giving context. We have further evidence that the Great Kings across the region considered iron a luxury good at this time and in fact, the goods were still mostly produced of meteoric iron (Bryce, 2003, p. 97). The Assyrian king Adad-nirari wrote to the Hittite king Hattusili asking him to send him some iron since it was a valued good and was given a now famous reply in the so-called "Iron Letter":

> In regard to the good iron about which you wrote to me—good iron is not available in my armoury ["seal-house"] in the city of Kizzuwadna. I have written that it is a bad time for making iron. They will make good iron, but they have not yet finished it. When they finish it, I will send it to you. For the moment I have sent you a dagger blade of iron (p. 97).

This response has been taken to mean that the Hittites controlled manufacturing and even the "secrets" of its manufacture, presumably an involved smelting process, in the so-called "Hittite Monopoly." It was initially argued that Kizzuwadna was the location of the iron-works based on this passage until the area was explored archaeologically and none were found. This led to a closer look at the text that has since been re-interpreted. Since the king's armoury had no stores it would appear that there was not a significant amount of smelting in the industrial sense. In fact the reference to a "time for making iron," was subsequently argued to be reminiscent of an agricultural rhythm, in other words a sluggish, time-consuming, seasonal process. [Waldbaum, 1980, p. 80; re-affirmed in Waldbaum, 1999, p. 32]

Furthermore, although numerous Hittite texts mention iron, so do the literary sources produced by many other sites like Susa, Alalakh, Mari and Qatna (Muhly, 1980,

p. 50). It has been shown that the Hittites were fine iron-workers, but did not exceed the other peoples of the region in the quantity or quality of their iron (Waldbaum, 1980, p. 81, Waldbaum, 1999, p. 32 & Mirau, 1997, p. 107). Some authors now believe that Adad-nirari was overestimating the Hittite king's ability to obtain high value iron altogether and emphasize that the Hittite's king's need to delay him and his strategy are actually very telling (Bryce, 2003, p. 97). Hattusili provides him only a *single* dagger as he waits for more iron. The first point has already been made, it is apparent that there was not much Hittite iron to be had. The second point is equally important. If *one* blade were worthy of being an object of exchange between Great Kings along the elaborate prestige network of the ancient Near East that fact alone tells us its great value (Waldbaum, 1980, p. 80).

With these facts in mind, I advocate for the following argument: while iron was a luxury good used by kings of the ancient Near East for prestige purposes well into the Late Bronze Age, the seeds had already been sown for it to become something more. I would call our attention to the following facts. Notice that the shapes into which iron was fashioned for the occasion of Amenhotep III's wedding and this second letter were all quite practical (excluding the bracelets) and included the most crucial elements. Among the daggers the blades themselves in every case were iron, the body of the mace was iron as were the tips of the javelins. From the literary references alone it is clear that even when working in the service of the king for essentially ritual or ceremonial purposes the metalworkers producing iron would have gained the experience necessary to fashion real weapons and tools. Presumably, this body of knowledge would be passed down through time.

As we continue with this study our chief question is why did Egypt not enter into the Iron Age with its peers? I would suggest the following possibilities. Egypt was renowned among the great powers as a gold producer, perhaps the king's metalworkers were essentially preoccupied with gold and other softer metals to a greater degree than the other polities. However, the greater factor is probably how the relationship between the king and iron-producers appears to have changed throughout all the other areas of the ancient Near East.

The close relationship between the kings and iron-producers is hard to determine from the letters alone but it does seem further corroborated by the context of the archaeological evidence. In the Late Bronze Age from 1600-1200 BCE iron is found in greater quantity throughout a wider region in Egypt, the ancient Near East and Aegean. In most cases including Egypt and elsewhere *iron is found in wealthy or royal burials.* This is quite telling with the iconic example being Tutankhamun's pieces which Carter believed were gifts from abroad but Waldbaum argued were made by Egyptians.   In her estimation, regardless of where the raw meteoric iron for the headrest, chisels and amulet from his tomb derived the types were "peculiar to Egypt and thus manufactured there." If Waldbaum is correct we can only deduce there were workshops producing iron materials for the king. In Mycenaean Greece iron was found in the temples, palaces and sanctuaries (Waldbaum, 1980, pp. 78-79). If she is not correct, the objects were still most likely exchanged along the circuit of Great Kings with the same royal clients. The upshot of all of these contexts would argue persuasively that the patron-client system of iron manufacture is the likeliest to have held sway.

The entire structured, interactive world of the Great Kings gave way to a completely new world order. As I argued, it is my contention that there were probably some environmental or geological events (or even population pressures or civil unrest) but regardless of which of the initiating causes were at play, that many of the deciding changes that occurred were actually delivered in human form: the movements of particular groups and actors created a maelstrom of calamity that wreaked some havoc across the entire region and ultimately created changes in the social relationships between iron-clients and iron-producers paving the way for the completely new role of the metal that we just noted was truly already there in its incipient form. Because of the experience workers already had in creating practical forms of metal for prestige goods, the germs were laid for the vast changes to come. Soon many more people would have access to iron and it would explode in its frequency of appearance in some areas of the wider region because its uses could now be exploited by so many more people. Therefore, I see the societal and social causes as key precipitators of great change at this time period. If change came in the form of human actors what evidence do we have for who they were and how can we make a case for how this drastic societal change in the Iron Age came to be?

Egypt's "End of Empire." Approximately 1224 BCE, the Nineteenth Dynasty ruler Merneptah records an enormous attack from the western desert by an alliance of Libyans and "northerners coming from all lands" who came to be known by the name

“The Sea Peoples.” Although this invasion seemed significant at the time it was only a hint of the scale and types of migratory movements that would be seen throughout the period. These movements were different in character, scale and in the occupations of the populations than those that preceded (Sandars, 1985, p. 9). Later under the pharaoh Ramses III (r. 1187–1157) the massive, coordinated attacks by some of these same groups would culminate in one of the most significant events that has come to be known as the “Great Sea and Land Raids.” These events are depicted pictorially and described at his temple at Medinet Habu. We are told that “as for the foreign countries, they made a conspiracy in their islands. All at once the lands [i.e. the people] were on the move, scattered in war” (p. 119).

In terms of the scale of attacks, what these people had accomplished already was astonishing:

> No country could stand before their arms. Hatti, Kode [Kizzuwadna], Carchemish, Arzawa and Alashiya. They were cut off. A camp was set up in one place in Amor [Amurru]. They desolated its people and its land was like that which has never come into being. They were advancing on Egypt while the flame [perhaps the Egyptian navy or a reference to scorched earth tactics] was prepared before them. [p. 119]

After leveling no less than five kingdoms of the ancient Near East leaving them facing destruction or disarray and setting up a camp in a sixth kingdom they were now ominously heading towards the Egyptians who had prepared a navy to lie in wait for them. We then find out the names of these people and that they were tribal groups or bands organized into a federation:

> Their league was Peleset, Tjeker, Shekelesh, Denyen and Weshesh, the united lands [i.e. the people]. They laid their hands upon the lands to the very circuit of the earth, their hearts confident and trusting: “Our

plans will succeed." [p. 119]

The pharaoh's preparation had involved placing his warships, transports and merchant men at the mouth of the Nile with the fighting men aboard the ships at the ready. Between the Nile and the frontier were his best princes and commanders. His chariotry was organized to include runners and hand-picked men of the elite warrior-caste known as the *maryannu* (p. 119).

The first battle took place on the land between Egyptian chariots manned by teams of two men, each against the invading foe who were fighting in the Hittite style in chariots manned by three men apiece. In addition to the accompanying flurry of confused activity caused by the hand to hand skirmishes there was the surprising presence of two wheeled oxen carts—agricultural vehicles— pulled by four humped zebu cattle (known from Anatolia and Mesopotamia) on each team. Their passengers included women and children among the fighting men providing us a key piece of information: this was not intended as a mere raid or battle but an actual full scale invasion followed by a settlement of the warriors and their families. Depictions show the ox-carts were especially vulnerable with a child even falling out of one (pp. 120-124).

The battle by sea was a true rout. On the north wall of the Great Temple at Medinet Habu depictions show five attacking ships with unusual bird-heads at the prows and sterns, one of which has capsized and resulted in total melee. The four Egyptian boats gained the advantage by ensnaring one boat with a grappling hook and shooting arrows at men armed with long swords. In the aftermath of both battles the surviving men were taken prisoners for the gods of the temples (pp. 124-131).

While the exact origins of the tribes are subject to controversy it is apparent that they were organized enough that they were able to appear in a famous and forbidding land like Egypt well equipped for battle on several fronts. Notice they were also clearly not the migratory, semi-nomadic raiding populations that one expects involved in similar warlike activities. The presence of their oxen, agricultural carts, women and children argue for many of these people being farmers willing to undertake an act of real aggression and desperation in order to make their flight to Egypt permanent.

Although the Egyptians were victorious that day this battle is also sometimes seen as the beginning of the long, slow decline from which they would never recover. After having reached the heights of the Bronze Age kings who reigned in splendor and glory like Thutmosis IV, Amenhotep III and Ramses the Great they spent the next five centuries in the relative instability of the Third Intermediate Period (1076-723 BCE) only to become centralized again when they were taken over by the Nubians (Winks & Mattern-Parkes, 2004, pp. 41-43).[57]

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[57] There is an important alternate way in which to view the so-called "intermediate" periods of Egypt's history. Mark Lehner notes that up to one-third of Egyptian history was spent in its formative or intermediate phases totaling 905 years (2000, p. 277). Rather than viewing these periods "as exceptions to the normative Egyptian state, with the curtain of royalty lifted the intermediate periods may offer windows onto the real social-economic texture that made Egypt work in all periods." He then asks in the next sentence, "What was the nature of ancient Egyptian society that would allow the rise of a nation-state across a large territory, its endurance over long-lived dynasties and kingdoms, its periodic dissolution into competing smaller scale polities, and its reemergence in great cycles?" (p. 277). His answer is that Egypt's history was guided by the fact that its smallest organizing unit was the household (temples, tombs and the palace were all based on the household model) which he believes allowed Egypt to survive relatively intact for millennia (2000).

Likewise, if we look at the Third Intermediate period specifically although there was little new construction in comparison to other periods there was a flowering of stylistically and technologically innovative bronze metalwork, exquisite gold and silver burial equipment from Tanis and other creative output (Allen & Hill, 2004). Similarly abroad, within the "Dark Ages" of Greek society were laid the foundations of the emergence of philosophy, science, art and new forms of government of the 5th century BCE and the "Fall" of the Roman Empire was the beginning of the rise of Western Europe as it is known today. Nonetheless, however one characterizes these transformative periods and their subsequent recoveries the main point I wish to make is that Egypt survived this particular episode relatively intact

There are two important points here. The attackers of Egypt came from their north and some came by sea, those facts are clear and give us some clues as to the direction from which so much change arrived. In addition, in spite of Egypt's new place on the international stage it did remain an intact state with the same basic institutions of control such as the kingship and temples in spite of their many power struggles with one another, a crucial distinction in comparison to the cities and states to their northeast which had already fallen before these invaders. I would argue that the fact that Egypt did remain a state with the same overall societal structure is actually one of the reasons it did not enter the Iron Age at this time, a point to which we will return. At this time, let us compare the events in Egypt with those that occurred elsewhere.

Syria. A further clue as to the grand scale of destruction comes from the Rap'anu archive of letters that includes an eyewitness account of a young vassal king from further up the coast of the Mediterranean in modern Syria at the important city-state of Ugarit. The preserved texts bear a dramatic first-person witness account providing details like the direction from which the assailants came, how they were traveling, some of their actions and the desperation of the people under attack.[58] They are a rare case of eyewitness accounts calling out to us over the centuries, but not the last.

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whereas some other ancient city-states and empires of the ancient Near East and Aegean were transformed to a greater degree.

[58] The precise date of Ugarit's destruction cannot be determined precisely, however. A letter from Ugarit to Ramses III in his eight year around 1190/1185 BCE provides a clue. The fall of Emar is argued to have occurred around 1187 BCE and is believed to be a part of the same events, nonetheless no clear date can be established for Ugarit's fall although it appears to be around this 1200 BCE date. All that is known is that this important site was destroyed while some sites further inland may have survived (Watson & Wyatt, 1999, footnote 427). This does argue, however, for a probable sea route for the attackers.

The overall picture that is presented is that of a raiding party or more likely, parties that came by sea and committed quick, damaging onslaughts and then retreated (Drews, 1993, p. 13). Letter RS 20.238 was sent to the king of Alashia whom the younger king addresses as "father."

> [B]ehold, the enemy's ships came (here); my cities (?) were burned, and they did evil things in my country. Does my father know all my troops and chariots (?) are in the land of Lycia?... Thus, the country is abandoned to itself. May my father know it: the seven ships of the enemy that came here inflicted much damage upon us […] (p. 14)

The young king begs for help but none is forthcoming and his site is ultimately burned to the ground. Other coastal sites met a similar fate: the settlement at Ras Ibn Hani was destroyed[59] along with Tell Sukas. Four more sites were demolished deeper inland in western Syria up the Orontes River at the very same time, namely Alalakh, Hamath, Qatna and Kadesh. In northeastern Syria another site with important documentary evidence was laid waste as well. Two tablets describe Emar as having been descended upon by nameless "hordes of enemies" that attacked the city around 1185 BCE (pp. 9 & 14).

The Southern Levant. In the Southern Levant nine sites were ravaged and devastated by fire around the same period: Hazor, Akko, Megiddo, Deir ʻAlla, Bethel, Beth Shemesh, Lachish, Ashdod and Ashkelon. Several were along the Via Maris, the area that connected Egypt to Syria which had been under the hegemony of Egypt until the fateful events that saw them destroyed. Among the most important pieces of evidence from any of these sites is a vase from the site of Deir ʻAlla, known as Succoth in ancient

[59] Unlike some of the other destroyed sites, Ras Ibn Hani was re-used shortly after being destroyed (Drews, 1993, p. 14).

times. The vase bears a cartouche with the name of Queen Twosret which means that the settlement was probably destroyed after 1190 BCE (pp. 9 & 15-16)[60]

Anatolia. Anatolia's destruction is among the most extensive. The Hittite empire was laid waste from its capital at Hattusas to every other important Hittite site with a total of approximately thirteen sites being ravaged overall. In addition the famous city-state of Troy that was not a part of the empire was also destroyed. This was the second region that included a superpower to be forever altered by the events of the Bronze Age Collapse, but unlike Egypt they would not continue to exist in their previous form. Even well-fortified sites were no match for the attackers. Hattusas was reduced to rubble, the walled city to its southeast, Alishar was destroyed by fire as well and to the east the palace at Maşat Höyük that had been able to withstand the forces of the Indo-Europeans known as the Kaskans was similarly destroyed (Drews, 1993, pp. 8-9).

The evidence in Anatolia also speaks to just how complex the destruction for this time period truly was; the story at a few sites is much more complicated than a mere fiery destruction. It appears that Troy – a city located in northwestern Anatolia not too far inland— was razed at least twice for there are two burn levels. Troy VIh may have been a citadel in which a royal family and their attendants and warriors lived until falling to some enemy in the 13th century BCE. A subsequent re-occupation by non-elite people with much smaller houses from the same culture followed until they too were destroyed around 1190 or 1180 BCE when the most widespread disasters were occurring across the Eastern Mediterranean. Amazingly, this was not the end of Troy's history. The

[60] Again the single scarab providing this date means that we cannot be assured this date is correct, but it does appear that a number of sites were met with similar fates around the same time period.

surviving members actually rebuilt the fortifications yet again and lived at the site until the end of the next century. Two other sites not too far from the coast on the southeastern part of Anatolia, Mersin and Tarsus, were also destroyed around 1190 BCE yet re-occupied as well (pp. 10-11).

The days of the Hittite empire had come to a close as the major sites did fall to the attackers which disrupted the power structure enough that they were unable to regain their former stature and they fell apart into separate, much less formidable polities. In fact, after this time the kings of the Syrian city of Carchemish began to be emboldened enough to call themselves by the august title the “Great King of Hatti” shortly after the destruction of Hattusas (p. 14).

Mesopotamia. Mesopotamia gives us an enormous clue as to the nature of the attackers, they appear to have been focused or most able to cause damage along sites accessible to Mediterranean coastlines alone, even if they were then able to sail upriver as they did on the Orontes. Mesopotamia was either protected by geographical barriers or by their own aggressive polities—namely by the Assyrians who may have in fact been beneficiaries of the instability that surrounded them. The Kassites were in control of the area of Babylonia until they finally succumbed after fifty years of war with the Assyrians. [Winks & Mattern-Parkes, 2004, p. 43]

Cyprus. The cities of Cyprus faced much abandonment and destruction as well with four cities bearing the brunt of the damage. On the southern coast of the island Paleokastro and Kition were sacked and burned while to their north Sinda on the interior and Enkomi near an inlet along the coast were also affected. All four sites were rebuilt after the major events of the Collapse, with the reoccupation of Paleokastro lasting about one generation until it was abandoned altogether (Drews, 1993, pp. 9 and 11-12).

Abandonment is an important theme at Cyprus, the smaller sites of Ayios Dhimitrios and Kokkinokremos were deserted around the time of the Collapse. At Kokkinokremos we see a very important piece of evidence regarding the role of metalworking in these catastrophic events. A bronzesmith hid tools and copper ingots in a courtyard pit, a silversmith hid two silver ingots and scraps in a workbench between two stones and a goldsmith hid jewelry and gold sheets in a pit. None of them were able to retrieve their goods which suggests to Robert Drews that they had been killed or enslaved (p. 12). What it demonstrates to us is that metal was one of the goods those who were ravaging their way across the Eastern Mediterranean sought. There is even more direct evidence that this was the case to be found among the eyewitness accounts from the early Greeks.

Mycenaean Greece. Mycenaean Greece is the most consequential place to study during this time period because 1) they have a combination of contemporary records that describe the arrival of strange attackers to their north as well as possible mythic memories of the events that survived later, 2) they have so many sites that were destroyed and 3) it has been argued that displaced Mycenaean Greeks were among the raiders that destroyed other polities after whatever raiding and/or wars wreaked havoc upon their populations first. This includes the theory that they were the "Sea Peoples" whom the Egyptians battled before the end of the heights of the New Kingdom (c. 1539-1077 BCE).

On the Peloponnesian peninsula Teichos Dymaion, Pylos, Nichoria, the Menelaion, Tiryns, Midea and Mycenae were all destroyed around 1200 BCE. In Attica Thebes shows a similar destruction level; the island to its east, Euboea, saw the site of Lefkandi affected in the same manner and to their north the site of Iolkos met the same fate. Altogether twelve major sites were affected: ten major sites in mainland Bronze Age Greece (only Athens was spared) and possibly two sites on Crete, these being Knossos and Kydonia. [Drews, 1993, p. 9 & pp. 21-23]

The archives from Pylos were preserved: ironically by being burned into immortality by the fires that destroyed the city. The preserved tablets reveal that the enemies came by sea from the north and that they were vicious and determined in their actions. The people of Pylos tried to protect themselves by placing "watchers on the coasts" and sending out hundreds of people to row warships in response. It was not to be successful. We know from another tablet that "the enemy grabbed all the priests and murdered them by drowning" which suggests that the temples were a target (Kidner et al., 2009, p. 29). Could it be that the riches in the temples and the similarly bedecked palaces were the reason that the palace-centered coastal cities were such a target? Is it possible that either food and/or the metals that could be melted and fashioned into tools and weapons were the objects of plunder since both could be found in these locations? As for the people of Pylos their skeletal remains were not found so presumably they were able to escape, possibly partially or mostly unscathed. Again, their dislocations like so many others *must* have caused some of the instability and overall chaos that occurred at the beginning of the Iron Age. A direct consequence was that the Mycenaean trade fell into a depression. [pp. 27- 29]

Some believe that the Homeric tales in the *Iliad* and *Odyssey* describe the events that occurred at this time in mythic form. Kidner et al. argue that these stories provide the first appearance of the Sea Peoples in the historical record. The Trojan War's essential elements are thought to be overall quite accurate by these authors. The tale of the Mycenaean King Agamemnon who assembled a Greek coalition of one thousand ships with about fifty men per ship to attack the rich and powerful trading city of Troy against which they successfully laid siege in a ten year long war would have occurred about 1184 BCE. These authors note these details comport with archaeological discoveries at Troy and the Egyptian accounts. The Egyptians refer to the Sea Peoples by several names including the Danua and Akawasha which the authors believe refers to the Danaans and Achaeans, Homer's names for the Greeks (2009, p. 28). The authors consider it quite possible the Mycenaeans were "caught up in the southward movement of the Sea Peoples and that Troy was one of the first places to be attacked" (p. 29).

Compiling the Evidence. My own assessment would be somewhat similar with a few cautions. One has to explain the eyewitness accounts from Pylos that describe a very desperate or vicious (or both?) enemy that arrives from the north whom they do not know by name. One must also consider this a key area where we are left with a mystery. What seafaring people to the north of the Mycenaeans could destroy all of their cities? Considering the great military prowess for which they were known by land and sea it seems shocking that they were forced to flee for their lives so easily. Then it seems quite plausible that Mycenaean warriors on the loose continued to cause havoc through battles and raiding, in fact many authors believe that the decades of wandering and peril in which the kings and warriors found themselves were actually what Homer's *Odyssey* encapsulated in mythic form.

But why were they on the run? And why were they so successful in their attacks? It was long argued that this was because they were armed with iron but it has become clear that this line of reasoning was not correct.

The role of ironworking in Bronze Age Collapse theory. It was once widely believed that all of the far-reaching, society altering, calamitous events listed above were the result of the one new technological advance: that of new ironworking methods. Early in the twentieth century most scholars who studied these events had beliefs that were shaped by Greek scholarship. A literary interpretation fostered the argument that there had been a massive Indo-European expansion into the Balkans known as the Dorian invasion. It was believed that the Illyrian tribes' movement into Phrygian and Dorian territory caused the latter to advance upon western Anatolia and Greece which they did successfully because they had acquired iron from the Illyrians. There were several pieces of the puzzle that were already confusing for this narrative. It was not known if the Sea Peoples had iron and the biblical passage in the book of Samuel in the Old Testament (1 Samuel 13.19-21) that mentioned that the Philistines also had iron from around this time period could not be explained. Furthermore, the theory could not account for how any of them acquired iron in the first place.[61] [Drews, 1993, p. 73]

[61] In *The End of the Bronze Age: Changes in Warfare and the Catastrophe Ca. 1200 BC* Drews also argues "the passage [1 Samuel 13.19-21] did not mention iron" as another reason that this early twentieth century

V. Gordon Childe's 1942 theory was also quite influential in the social sciences outside the disciplines of Egyptology, Assyriology and the archaeology of the Aegean and ancient Near East. It differed from the previous ideas in several ways. Childe believed that ironworking had originated in Anatolia by the Hittites in the thirteenth century BCE rather than central or northern Europe. Like others he argued that the Hittites were able to keep their iron-production processes a secret which he believed enabled them to subjugate other populations until those people rebelled. According to this theory, the rebels were successful in toppling the Hittite monarchy upon which they took to the sea. They and other "barbarian" hordes were able to destroy most of the Bronze Age palace-centered kingdoms afterward which then had some rather surprisingly positive outcomes: iron weapons soon gave way to iron tools for the masses (Drews, 1993, pp. 73-74).

The role of ironworking in the Bronze Age/Iron-Age transition as demonstrated in the archaeological record. Suddenly, non-elites were able to afford iron hoes, plowshares and saws which meant that this period saw "not only the destruction of the old centers of power but also the most important shift in the class struggle in the five thousand years between the Urban Revolution and the Industrial Revolution" (p. 74). Robert Drews argues that although Childe was incorrect in his

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theory was problematic (1993, p. 73), however it should be noted numerous translations of the Old Testament do mention iron.

For instance, the following translation of this passage makes it clear that the Philistines had a monopoly on iron to keep the Israelites from fashioning weapons: "The Philistines would not allow any Israelites to learn how to make iron tools. 'If we allowed that,' they said, 'those worthless Israelites would make swords and spears.' Whenever the Israelites wanted to get an iron point put on a cattle prod, they had to go to the Philistines. Even if they wanted to sharpen plow-blades, picks, axes, sickles, and pitchforks they still had to go to them. And the Philistines charged high prices." (Bibles.org/CEV) assessment of the role of iron, it was important for noting that the Bronze Age (c. 3000 BCE-1200 BCE) had been dominated by kings and elites whereas "in the Iron Age the common man counted for something" (p. 74).

Two other works were written in the same vein. In the 1973 book *The Tenth Generation: The Origins of the Biblical Tradition* George Mendenhall argued that momentous conflicts occurred every 250 years, i.e. every tenth generation. In the 13th century he proposed that the Anatolians immigrated to Canaan with iron which allowed them to set themselves up as the ruling elite. In 1200 BCE the Canaanites revolted and destroyed many of the cities creating the calamitous ending to the era. Norman Gottwald's *The Tribes of Yahweh: A Sociology of the Religion of Liberated Israel, 1250-1050 BCE* the origins of Israel were also seen to be the result of the introduction of iron. Again, it was seen to have been introduced to Canaan via the Anatolians. In his view when Israelite peasants had iron axes, spades and plows they were able to create surpluses that enabled a social revolution that changed the course of their history (Drews, 1993, p. 75).

What is interesting is how wrong all of this elaborate, well argued and often convincing argumentation has turned out to be. As we noted in an earlier section, a new kind of archaeologist began to produce much more systematic studies in the late 1960s and early 1970s that effectively demonstrated that large-scale ironworking production and use *antedated* the Bronze Age Collapse by more than a century (p. 75). Drews offers the following important observation that I find compelling: it may have been the case that the Bronze Age Collapse contributed to the production of iron but “it could *not* have been the other way around” [emphasis mine] (p. 76).

It is not only V. Gordon Childe who believed the Hittites controlled the secrets of smelting iron production. As recently as 2002 Partridge asserted that the first iron that appeared in Egypt in the Eighteenth Dynasty (c. 1539-1292 BCE) came from the Hittites whose use of the metal gave them an advantage over their enemies making them “understandably reluctant to pass the new technology on to others” (p. 14). This widespread, long lasting belief that the Hittites controlled iron smelting technology is based on the Iron Letter we mentioned and has been argued against (Mirau, 1997, p. 107; Waldbaum, 1980, p. 81; Waldbaum, 1999, p. 32).

New and Increased Networks of Interaction and Change in Relationships between Iron Producers and Iron Clients: Technological Advances and Increased Distribution as a Result of Societal Change

Although the theory of the Hittite monopoly appears less tenable than it did when first proposed, the destruction and decentralization of power once held by kings and elites and the new role of the “common “man/person” bear rescuing. Stated in a different way this idea describes the situation which I argued explains how new methods and greater amounts of iron production are a result of new political and societal realities. The reduction of the royal houses as a means through which iron was produced and then disseminated internationally in a very elite network of exchange in extremely small amounts for purposes of prestige and presentation was a profound event. When iron production emerged next it was amidst new societies where iron producers were clearly not as closely aligned to royal houses and the elite. The emerging farmers, raiders and other individuals who were purchasers of tools and weapons were freer agents from the lower classes. They were now part of their own chaotic, migratory networks of interaction and probably exchange that could include contacts from land and sea. A single circle of kingly exchange was now expanded infinitely in all directions across the ancient Near East and Mediterranean Sea with endless nodes that included interacting farmers, raiders, bands, merchants and other seafarers. The almost infinite increase in the types of exchanges, the routes of exchange and potential actors who could buy or sell iron explains the vast increase in the types and frequency of iron: the social change produced great technological change and even set the condition for there to be more experimentation in production methods and tool and weapon types since the audience and their needs had expanded so much. In this way, we can argue that this technological transition from the Bronze Age to the Iron Age from which the new age gets its name was delivered by the movements and relationships of freer actors amidst a greatly altered and much more chaotic world.

Why does the Iron Age Escape Egypt for Six Hundred Years?

Why is Egypt alone in the region in not entering into the Iron Age at this time? I would argue that in Egypt the basic order of the society had more stability. Their elite expressions were centered around gold which was limited on the Late Bronze age trade circuit (Bryce, 2003). They had copper although not tin for bronze but in the Third Intermediate Period they also had less need for bronze as they were not going to war and maintaining an empire.

The very nature of the evidence from this time period belies an extremely important distinction between the regions. In Egypt, the evidence of this time period of massive destruction comes from a very prominent record by a pharaoh, Ramses III, able to claim victory (whether or not we believe he was as successful in repelling the invasions as he claimed, he did survive them) from the walls of a temple that was *not* destroyed. Egypt was not like so much of the rest of the region where we saw massive destruction levels and entire polities laid waste.

Egypt continued to be under pharaonic rule, the temples were not destroyed, the elite members of their society continued to exist and the common person's position in the overall structure was not altered as radically as it had been elsewhere. It was no longer an international power in the way it had been but other structures and expressions of wealth continued to order the society. The level of decentralization of power was not as great as elsewhere and the basic economic relationship between iron producer and iron user may have remained more similar. The very forces that kept Egypt a special case of an intact polity in the aftermath of the Bronze Age collapse, I would argue, ironically kept it from some of the technological developments of her neighbors.

If the long-stated and oft-cited theory that an influx of Greeks in the 6th century BCE finally brought their smelting methods to Naukratis and Tell Defenneh is true (which I would argue is possible and likely based on current evidence) then we can now see how that occurred. The range of tools and weapons that appear at these sites include many implements of a functional nature across a wide variety of types (for examples of types of iron implements that first appeared in Egypt see Appendix B, Figs. 3 & 4).

Why? Because what we can deduce from all the evidence above is that this new iron-producing technology was the *product* of six centuries of experimentation, chaos, destruction, warfare, mass movements of people followed by a re-ordering of society and resulting metallurgical advances that occurred throughout the entire Mediterranean and ancient Near East. This also explains why iron advances were not accepted as widely across all of Egypt. This new, practical form of ironworking was not indigenous or necessary to ancient Egyptians. They were probably capable of producing more practical forms of iron since at least the Bronze Age (or could have easily become so) but nothing necessitated that they fully adopt this new technology as their society had not undergone the degree of collapse, destruction and the re-ordering of their economy and social structures that their neighbors did.

What changes in the Roman era (30 BCE-395 CE) account for the higher degree of adoption of iron and why would they abandon iron so precipitously at the end of the Roman era? We are fortunate to finally be able to see the cultic activities of some iron-workers for the first time in history during this era to provide clues into their mindset. In addition, we do know that they were absorbed into a different economy with a higher degree of interest in iron.

Ironworking in Greco-Roman Egypt

Summary: The one era for which a group of iron-workers may be best known in Egypt is the Greco-Roman period in the third to fourth centuries CE after Egypt had been absorbed into an economy with a greater degree of interest in iron. A group of inscriptions at Hatshepsut's temple at Deir el-Bahari leaves behind a record of the iron-workers' cultic activities. In this section I offer the new hypothesis that the mysterious gods they were worshipping were the main inhabitants of the temple: Imhotep, perhaps in his guise as a "son of Hephaistos" who was a Greek god of iron, volcanism and smithing and possibly Amenhotep son of Hapu, a deity who had been a patron to craftsmen in life and whose priesthood was populated with workers. I argue that the reason their worship came to an end was not only the coming of Christianity but also widespread economic and political disruptions that affected iron production known as the Third Century Crises of Rome.

The Romans were committed to extracting resources including metals like gold, copper, tin and iron from every extent of their empire which ultimately gave them an unparalleled knowledge of the nature and variety of resources one could obtain from widely separated geographical areas. In Pliny the Elder's *Natural History* (c. 77 CE) he writes:

> There are numerous varieties of iron. The first difference depends on the type of earth or climate: some lands furnish only iron soft like lead, others a brittle and coppery kind whose use is especially to be avoided for wheels and nails; for these things the former [soft] characteristic is suitable. Another type is only good for short lengths and nails for soldiers' boots, another suffers rust more quickly […] At different times and locations the water has proven more useful and made the places renowned for the fame of their iron such as at Bambola and Tarragona in Spain and Como in Italy, although no iron mines exist in those places. But of all the types of iron, first place goes to the Serie [Chinese?] iron; the Seres send it with cloth and skins to us. Second place goes to the Parthian iron since no other irons are forged from pure metal; all the rest have a softer alloy welded with them. In places such as Noricum in our part of the world, metal in the vein furnishes this good quality, while in others such as Sulmona it is due to the working, at others, as we have said, it is due to the water. [Book 34, 143-145]

Although Pliny evidently believed the best iron came from China, many experts now believe this iron was *Wootz* steel[62] from India. Parthia where the second best iron was located is in modern Iran and the iron of Noricum which he also thought was of good quality is located in modern Austria (Sim & Kaminsky, 2012, p. 58). Altogether we do see clear evidence for an empire-wide distribution of quality iron available to the Romans, with modern day experts arguing that ores from Spain were available to the Egyptians by sea lanes under Roman rule (Coghlan, 1977, p. 43).[63] Iron was extremely necessary to the Romans for their military, building methods and other purposes. It certainly gave them both the tools to expand their empire and sometimes, evidently, the impetus to expand into particular areas where they might acquire more iron. The Romans may have even expanded into Britain partially for the iron alone and they are known to have mined iron in Gaul, Elba, Sardinia, Sicily, central Europe, Illyria, Macedonia, Asia Minor, Rhodes and Africa (Travis & Travis, 2014 Appendix 3 & Pliny's *Natural History*, Book 34).

The Weald in southern Britain, for instance, is particularly rich in iron ore (Bray, 2010, p. 178). Similar to what one sees in Egypt, Roman rule actually brought about a very great increase in the production of iron in Roman Britain. Bray attributes this

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[62] Wootz steel was an ultra high carbon steel with 1-2% carbon that may have been used to create Damascus blades. The term "wootz" is an anglicized version of the Indian word *ukku* which means steel making the term "wootz steel" redundant. It was fashioned in crucibles (Craddock, 1995; Bronson, 1986 & Srinivasan & Ranganathan, Smith, 1960; "Wootz Steel: an Advanced Material of the Ancient World," n.d.).

[63] There is circumstantial evidence that corroborates this theory. Red pigment on the shrouds of portrait mummies of the 2nd c CE came from silver mines in Rio Tinto, Spain in the Roman era thus demonstrating that goods were traveling between Roman Egypt and the mines of Roman controlled Spain (Walton in Corcoran & Svoboda, 2010, p. 104).

situation to the following “stimulating” factors: 1) an increase in taxation that required those with access to smelting facilities to increase their output 2) the stability of the Roman Empire that allowed for such a strategy with lessened risk 3) expanded markets became available to the smelters so that their products could actually achieve greater profit (p. 182). These same factors may have affected the output of iron production in Roman Egypt as well and could provide an explanation for the increase.

The result of the widespread interest in iron throughout the provinces was considerable. At the height of their activities the yearly output of iron in the Roman Empire is estimated to have reached an astounding 84,750 tons. This exceeds any other contemporaneous culture, including China in spite of the fact that the Han Chinese populations were higher by many orders of magnitude (Craddock, 2008, p. 108).

The technical prowess of the Roman Empire can, however, be deceptive and misleading in some respects. The ancients had an entirely different conception of iron than we do. Although the chronology established in this dissertation and the arguments of quite a number of archaeologists are predicated on a modern conception of iron as a product of technological advances ultimately used for “practical” purposes this does not describe the ancient view at all which is why we have also argued that socio-cultural factors shaped iron use as well. Even at the height of Roman iron production, like most ancients, they conceived of iron and other metals as organic products. Iron was believed to grow from the Earth like a plant which is why the ores Pliny described were seen to take on vastly different characteristics depending on their environment (Craddock, 2008, pp. 106-107).

Pliny also makes it clear that the Romans were very keen on using iron for all manner of activities: planting of trees, laying open of the ground, preparing vineyard trees, warfare, "murders and robberies" and delivering death from a distance from "winged weapons" which he believed was the most "criminal artifice that has been devised by the human mind" (39.14). Furthermore, iron could be used for medical treatments including incisions and what we would term magical rites. Even the most seemingly "practical," "utilitarian" of objects could be used for these medical/magical aims. Although it is true the ancients' saw magic as efficacious it does differ from the way archaeologists view practical, useful objects. He reports that if one traced a circle around an infant or adult with an iron weapon or point they would be protected from all "noxious influences." If a nail were removed from a tomb and placed in the threshold of one's door it would prevent nightmares. Water into which iron was plunged at a white heat could later be used as a "potion" against all manner of diseases including dysentery. [Pliny *Natural History* Book 34.44] Rust scraped from old nails could repair wounds, cure alopecy (baldness) or alleviate gout (34.45).

Being absorbed into the Roman Empire after the death of Cleopatra VII would have provided the ancient Egyptians with new building methods requiring iron, a renewed interest in mining, a heightened interest in iron production and possibly new attitudes to iron as well. The Egyptians would have harbored some similar beliefs about the magical properties of iron but were certainly now in contact with Roman citizens and Greeks who definitely held such beliefs (more on this below) and were a lot more focused on them.

Although we have established that museum Egyptian iron collections peak at this time and ongoing excavations at sites like Amheida at the furthest reaches of the Roman frontier in Egypt are currently producing quantities of iron that are equaling that of bronze, much about iron production at this time remains poorly understood ("Amheida," 2016). This is why the inscriptional material that refers to the first identifiable iron-workers is so crucial. If we examine their life and times we see an interesting mixture of Greek and indigenous Egyptian cultic practices in their visitations to an iconic temple as well as possible reasons for the fact that they ended their temple visitations after a period of time. It has previously been speculated that the coming of Christianity ended their temple visitations but I would like to examine the possibility that it was much more than that. As we have noted in the historical section when we established a more nuanced Iron Age chronology, there was a precipitous drop to iron production as a whole at the end of the Roman era (c. 30 BCE-395 CE) as well which coincides with the end of the evidence for the iron-workers' religious cult. I will argue that these events are inextricably linked together.

The Iron-workers of Armant

During the fifty year time period between 283/284 CE to January 26th, 334 CE, a small group of approximately twelve to fifteen iron-workers trudged the twenty kilometer path from their home town of Armant (Hermonthis) to a natural rock "amphitheater" at a site called Deir el-Bahari perhaps once a year. There the iron-workers would congregate upon the upper terrace of a limestone temple built eighteen hundred years earlier by the famous 18th Dynasty female pharaoh Hatshepsut (r. 1479-1458). It was now mostly buried beneath the sands and being used for very different purposes than its original intent. These workers— a very enigmatic lot it turns out— regularly made this pilgrimage in order to spend a couple of days and nights feasting and performing their own peculiar religious rites for some "great god" who is also shrouded in mystery.

What is significant about this evidence is that for the first time in Egyptian history we will hear the first person voice of the iron-workers themselves in a historical context that has several points of entry from which we can tell something about the circumstances in which they lived and how the tumultuous economic downturns were reverberating throughout the region. The town of Armant from which the workers hailed has what is currently the longest, although extremely sporadic evidence for ironwork in all of Egypt. Its original excavators announced that if they only had the funds, time and personnel to excavate all of Armant (and been without the unfortunate outbreak of World War II and death of a founder of the project, Sir Robert Mond) they "should have had before [them] a complete crosscut through Egyptian history" (Mond & Myers, 1940a, pp. ix & 1). Not only was a Predynastic ring of unknown date (but possible 4th millennium BCE) found and then unfortunately disappeared, but we will see a later bit of evidence for Egyptian ironworking that will tell us something about the nature of their industry during the Greco-Roman period (c. 332 BCE-395 CE) many millennia later.

The entire Hermonthite nome was controlled from the seat of government at Armant; it included the West Bank of Thebes and Hatshepsut's temple which was a striking part of the larger Theban landscape and had become part of its necropolis. The temple was actually being re-used in part as a cemetery for non-royal commoners when the iron-workers visited it. The entire region has been excavated and recorded for two centuries which allows us to say even more about the site the iron-workers were visiting including the temple complex than we can about their home town. Although Egyptologists as a whole have been less interested in the Roman period at Thebes than the impressive finds from earlier periods (including the New Kingdom [c. 1539-1077 BCE] evidence from the many spectacular tombs) there are actually some intricacies about the economy, art, burial practices and history that have been investigated thoroughly enough to establish that this was a period of great change. Christina Riggs notes "Thebes in the Roman Period has been characterized with some justification as a city in decline" (2005, p. 175). What is more, thanks to the popularity of classical studies we know the Roman Empire was in similar financial straits; they were actually undergoing a notorious period known as the Third Century Crisis of Rome which had halted or adversely affected a multitude of activities including mining and the financial underpinnings of the empire.

Therefore, in this section we will finally gain access to the words of the iron-workers themselves, find they were visiting a temple whose use had spanned half the history of Egypt, see their religious worship of figures who had undergone millennia of change, note they were from one town and visiting another that are among the most long-lived or best studied in all of Egypt and discover they were now part of the Roman Empire which was undergoing a particularly raucous period of multiple crises. All told everywhere one looks the iron-workers were surrounded by historical processes whose trend lines can be followed over thousands of years. This offers our most significant opportunity to view these workers within their historical context. We will see examples of what is known as well as my own hypothesis about their religious activities including the answer to the question: exactly which mysterious god or gods were these iron-workers travelling this distance to worship?

Armant

The town of Armant - located on the west bank of the Nile in Upper Egypt- was known as Hermonthis to the Greeks and *Iwnw* to the Egyptians. Since it was the same name used for Heliopolis, Gebeleyn and Esna and means “columns,” one of the original excavators argued it may have referred to a town of special importance containing a sacred pillar or pillars that represented a temple or palace (1940a, pp. 1-2).

Mond and Myers found evidence at the town and cemeteries continuing from the Predynastic era all the way to the modern period. It was clear that the war god Montu was worshipped there in his hawk-headed form as well as his manifestation as a sacred bull, the Buchis. A burial place for the mummified bulls called the Bucheum was uncovered early in the twentieth century. The Bucheum was still an important part of Armant when the iron-workers were active although it would have been in its final days of use and significance as the cult disappeared and the religion changed. Armant’s many temples, state buildings, churches, Roman structures and mosques are testaments to its enduring importance, part of which may have been aided by the fact that the kings who reunited all of Egypt by advancing from Thebes after the First Intermediate Period may have originally called Armant home. [“Armant,” n.d.; “Bucheum,” n.d.]

What was the town like during the time period when the iron-workers were active? Although the dating is quite nebulous in the earliest investigations,[64] several key points do stand out with regard to this time. The excavator Oliver H. Myers believed "Neither the importance of the town nor the building activity in it declined during the Roman period in relation to the rest of the country" (Mond & Myers, 1940a-, p. 5). The evidence for ongoing building by the Romans is substantial. A later Coptic church clearly had reused large, granite columns that seem to have come from a large Roman forum. Roman baths, a temenos, gateway of Antonius Pius, gateway for a Roman temple and new granary all demonstrate that there was ongoing building that occurred throughout the era (pp. 5 & 9-11; Vandorpe, 1995, p. 231).

In the Late Roman period the great temple of Armant appears to have been destroyed in order to create a wall that Myers believed was a result of the incursions of the famous tribal people from the area of modern Sudan: the Blemmyes. Their pots were located within the town and they did take over the country as far south as Sohag so that it seems either the Blemmyes built the wall or it was built by the Romans to protect the inhabitants of the town against them (p. 10). This is one hint that we have that will come up again as we proceed, the Roman Empire did *not* have the hold they would have wanted on Egypt at this time.

[64] In a footnote that offers a fascinating window into the history of archaeology, Myers notes that he was only able to excavate the 4th century part of the Coptic town at Armant with any satisfaction. He goes on to state that he was living in the period when one could simply dig anywhere and find objects that would contribute to historical knowledge. He predicted this kind of archaeology was at its end and he rightly stated the future of the science would rely on statistical excavation, cataloguing objects and attention to chronology (1940a, p. 1, footnote 1). His work is free of such methods but does offer important discoveries including their find spots, lists of structures, broad dating when possible, a historical summary, building programs of some specific rulers, and many fine photographs and drawings.

As far as craftwork, a Roman pottery kiln was found as a result of one sondage (p. 31). Otherwise a later Coptic town provides the most information from the late fourth century (pp. 36-37). One room shops, furnaces and crucibles were located in this context. In addition, the most important object for this project—an iron steelyard of a possible earlier "pagan" date (i.e. probably contemporary to the iron-workers)— was located in one of the Coptic buildings on the floor with some other ordinary weights (p. 37 & Mond & Myers 1940b, p. 138 PL XXXI Fig. 4 M. 131 b; See Appendix B Figure 11). It would appear glass blowing, pottery making and metalworking were among the collection of economic activities that took place during the Roman period that would continue later in the town's history as well. The iron-workers were apparently specialists in an area where other specialized craftwork was taking place as well.

This provides us with the impression that Armant was a bustling, inviting and important town. That is how Myers interpreted his own results. It is difficult to be sure of that since other areas that are better documented provide a different picture, for instance there is the case of Thebes, the modern name for the area the iron-workers visited for their religious activities for about fifty years.

Roman Era Thebes: The "Museum City" of a Thousand Gates

In many ways Thebes could be argued to have been equally important to the Roman emperors as Armant if building programs are an accurate measure, which they might not be. The main temple at Karnak continued to be enlarged, decorated and restored by some Roman emperors; within Amun's precinct Augustus contributed to the temple of Khons and Tiberius reconstructed the chapel of Osiris-Coptites.[65] Tiberius restored Luxor temple after it was inundated and both Trajan and Hadrian founded sanctuaries for Isis and Serapis while Diocletian created a sanctuary for the imperial cult in Luxor temple among other notable additions (Vandorpe, 1995, pp. 213-214, 216, 220-221 & 237). All told, Thebes' history was much more illustrious than Armant's which contributes to the sentiment that it had farther to fall.

Thebes had been the capital of the country beginning under Nebheptre Montuhotep in 2040 BC with its state god Amun, it was home to many great temples and it had been the burial place of the New Kingdom (c. 1539-1077 BCE) monarchs and their families (pp. 203-204). By the Roman era all had changed. It became the seat of many significant rebellions that had to be put down, the capital had been moved to the north, the area was split into separate nomes for administrative purposes, the great temples were no longer in use (in their original manner), Luxor temple had a garrison of Roman soldiers stationed there to keep future revolts from taking place and no new tombs were being built (pp. 235-237). In short, it was a city experiencing a great reversal of fortunes.

Multitudes of burials in old tombs still took place and people lived in smaller communities among the ruins but its ancient grandeur was more of a tourist attraction in the Roman era. Pilgrims, travelers and emperors alike were still entranced by the "hundred gates" of the endless temples; the gargantuan statues known as the singing colossi of Memnon attracted the attention of famous writers and other structures spoke so well of Thebes' former glory that the researcher Bataille has claimed it became a "*ville-musée*" (museum city) to the ancients. This descriptive and evocative phrasing continues

[65] See also Klotz, 2012.

to influence perceptions about the Roman era at this site (p. 237). It paints a picture of a kind of Disney World of the past, Egypt's version of the Parthenon mixed with the Louvre as they are viewed today: a place where the glory was all rooted in a grand tour of its history rather than its contemporary economic and religious importance.

Although the picture is clearly one of drastic change, during the precise era that the iron-workers were visiting there are actually a few clues that some caution should be exercised in viewing Roman Thebes strictly as a living museum. Perhaps it had some qualities that were more like the Vatican (without a current Pope): one can imagine a large, city-sized tourist attraction for many people that still had structures with ongoing significance for faith-filled individuals such as the iron-workers.

For instance, Riggs has analyzed a group of twenty-eight mummy masks dated to the mid to late third century CE[66]—the very time when our iron-workers were making their visitations— made of plaster-coated linen. Several of the examples come from the temple of Hatshepsut at Deir el-Bahari. The mummies include naturalistic, painted portraiture of the deceased individuals' faces on the mummy wrappings that had come into fashion through exposure to Greek and Roman art. Nonetheless, Riggs insists that the religious ideals such as the transfiguration of the deceased into perfected beings and *ba* as well as the iconography itself were actually characteristically ancient Egyptian. Each of the intact masks included a *henu*-barque of Sokar with jackals wearing keys around their necks at each side and lotus buds and flowers rising behind them. Since the iron-workers were visiting Thebes from Armant at the same time it is important to note

[66] Stylistic reasons may point to a time prior to 270 CE but still within about a decade of the iron-workers' first recorded arrivals to Deir el-Bahari (p. 242).

that similar jackals with keys around their necks were found on stelae at the Bucheum from their home town, Armant. Yet the overall combination of the *henu*-barque of Sokar, jackals with keys and lotus buds behind seemed to her to be a specifically Theban design. [Riggs, 2005, pp. 232-246]

This time period coincides closely to the iron-workers' visitations and is marked by being the last period when Egyptian designs are found on material from Deir el-Bahari (or anywhere in Egypt for that matter) yet there is a very strong influence of Greco-Roman themes. This confluence of Roman-era Greek, ancient Egyptian and possibly specifically Theban religious practices into one configuration describes what I believe we see from the iron-workers' religious practices too. Riggs has argued that thousands of years of different religious practices, themes and iconography came together into the "beautiful burials" at Roman Thebes (2005). I believe we see the same for the cultic practices of the iron-workers. Let us delve more deeply into the history of the temple where they were to practice the cult activities with which we are able to become partially acquainted.

Deir el-Bahari: 1800 Years of Destruction, Alteration and Re-use

The group of iron-workers from Armant (Hermonthis) would be entirely unknown were it not for the fortuitous discovery of evidence of their religious activities that comes down to us from a group of inscriptions discovered at the temple of Hatshepsut at Deir el-Bahari. This location was one of a magnificent group of religious structures that were created for the worship of the highest, most renowned gods in the Egyptian pantheon and the pharaoh's own family.

Djeser-djeseru. The history of Deir el-Bahari involves three startlingly innovative structures produced by some of Egypt's most illustrious rulers. Queen Hatshepsut's (r. 1479-1458 BCE) magnificent Eighteenth Dynasty mortuary temple known as the *Djeser-djeseru* (holy of holies) was initially devoted to worshipping Amun, Hathor, Anubis, the solar cult and the royal cult as well as commemorating and legitimizing the monarch's rise from queen to pharaoh. These were many of the highest gods in Egypt and the original purpose of this temple was partially to make Hatshepsut appear to be the child of a god (Amun) and the rightful heir of the throne of Egypt. When it re-emerged eighteen hundred years later it was a beacon for ordinary pilgrims including the group of iron-workers who were worshipping much different deities (Wilkinson, 2000, pp. 175-80). In many ways these iron-workers can be said to have arrived only midway through millennia of very great changes which ultimately affected their own cult worship.

The initial construction of Hatshepsut's mortuary temple was a fifteen year-long project that is widely considered to have resulted in one of the most extraordinary examples of architecture in all of Egypt. Its three elegant ascending terraces were lined with porticoes and connected by large ramps on the entrance side arranged into a veritable stairway to heaven, a configuration whose steps delve straight into the rose-colored cliff face incorporating the temple directly into the Theban landscape.

The slim, squared off columns are unlike the majority of Egyptian columns that tended to be much more closely set and squat in appearance. The approach had a massive, 37 meter (121 foot) wide causeway lined with sphinxes that connected the valley to pylons. Just inside the first court one would have found an exotic garden with extraordinary trees and other greenery brought from an African land whose name reached mythical proportions, that place known as Punt. [Wilkinson, 2000, pp. 175-180]

Several elements provided the *Djeser-djeseru* with its enduring grandeur and importance. It borrowed design elements from the adjacent temple of Nebheptre Montuhotep II (r. 2009-1959 BCE), the very first ruler of one great period in Egyptian history, the Middle Kingdom, while still managing to dominate that ruler's structure by towering over it as Hatshepsut's temple was orders of magnitude larger in scale. It was never copied in its exact form again but it provided the main features that became the template for the later New Kingdom (from her reign up to 1077 BCE) temples of Western Thebes. The sanctuary for the solar barque of the supreme state god Amun was located on the main axis, there was a space with open access to the sun for Amun's altar which were to be provided by open courtyards or otherwise unroofed rooms in future temples, there was a room with a false door in order to provide the deceased with ritual offerings for sustenance in the afterlife and there was even a place to commemorate the royal ancestors themselves – a feature that would eventually become elaborated by the Nineteenth Dynasty when legitimizing the reigns of Seti I (r. 1290-1279 BCE) and Ramses II (r. 1279-1213 BCE) became of the utmost importance (Shafer, 1997, 95). Hatshepsut's temple actually taught some of the greatest kings of Egypt how to legitimize their own reigns.

Nearby the earlier temple of Montuhotep II was known as the *Akh Sut Nebheptre* "Splendid are the palaces of Nebheptre." It too had a causeway leading to a court lined with trees, along with six chapels and tombs for the ruler's wives and other family members. The ruler's own sanctuary and royal cult were located there as well. Between these two temples and slightly to their rear, the much smaller but quite important mortuary complex of the greatest warrior pharaoh and "Napoleon of Egypt," Thutmosis III (r. 1479-1425) was dedicated to the highest god Amun (Wilkinson, 2000, pp. 175-180). Three of the greatest rulers of Egypt, their families and the most important state sanctioned gods called Deir el-Bahari home.

Deir el-Bahari in the third through fourth centuries: a much altered state. Deir el-Bahari went through many periods of upheaval in the centuries that followed which meant the iron-workers found something much different than the original configuration. During the reign of Hatshepsut's co-regent and ultimate successor, Thutmosis III, her name and likeness were hacked away from her own mortuary temple, possibly due to tensions between the two monarchs or some other change in the political situation. During the Amarna period images of Amun, a competitor to the solar deity the new king Akhenaten favored, were destroyed and in the Nineteenth Dynasty (c. 1292-1191 BCE) the statues of Osiris were ruined possibly as an attempt to stamp out Hatshepsut's memory.

After the old gods were destroyed, it was then that new, more accessible divine inhabitants and their attendant priests had the opportunity to occupy their quarters. In the Ptolemaic era what had been the sanctuary of the god Amun at the *Djeser-djeseru* was restored and the cults of two architects who became patron deities[67] were included, these

[67] Egyptian patron deities are similar to phenomena found in other areas of the ancient world including China. These are a class of deities who had been important in life, built up a following and became

being Amenhotep son of Hapu and Imhotep. The first was included around the end of the fourth century BCE or beginning of the third century BCE when the cult of a former patron of workers, Amenhotep son of Hapu, was established in the upper terrace of the temple of Hatshepsut. André Bataille believed it was a continuation of his mortuary cult that had lasted almost a thousand years at Medinet Habu and was abandoned about the same time. Amenhotep son of Hapu was known for providing oracles and miraculous healings. [Latjar, 2006, pp. 14, 22-23]

An inscription states that Ptolemy III who reigned in the third century BCE built a chapel to Imhotep—whom he calls Asklepios—on the second terrace that was later expanded by Ptolemy IV to add a rock chapel and portico with six columns. The south side was devoted to images and inscriptions for Imhotep and the north side was reserved for Amenhotep. In this way the two patron deities came to cohabitate within Hatshepsut's temple for a far different clientele (Wildung, 1977, p. 63).

Inscriptional evidence makes it apparent that this is when the first much more "common," non-royal visitors began to arrive in great number to Hatshepsut's great temple. The upper court was a place where sick travelers would arrive to receive healing dreams which led some authors like J.G. Milne to argue it was a "sanatorium" (1914). Latjar contends that this interpretation is incorrect because visitors did not stay long enough to receive medical treatment although it is clear they did believe their health and concerns could be positively affected. Nonetheless, Latjar insists any treatment received

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worshipped in the afterlife. They were believed to have "effective" spirits, or *ꜣḫ,* that could work on supplicants' behalf in the afterlife.

would have been a result of the psychological benefit derived from their beliefs rather than long term, on site medical attention (2006, p. 56).

In the 7th century CE the temple became home to a Coptic monastery whose adherents destroyed and defaced many of the images of the gods whom they considered to be pagan deities. All told, by the time the first Polish-Egyptian archaeological team came to the site in the modern era almost all of the temple's art work was in such poor or destroyed condition that it all had to be reconstructed to the state of preservation one sees today when visiting this important site. [Wilkinson, 2000, p. 178]

In the third through the fourth century CE, in the middle of these cycles of use, abandonment and restoration the iron-workers of Armant would have seen an entire group of structures that had changed immeasurably. The two lower courts of Hatshepsut's mortuary temple and the great and innovative temples of Montuhotep II (r. 2009-1959 BCE) and Thutmosis III (r. 1400-1390) were allowed to become covered over by sand. What is more, now these sand-covered areas were being used as final resting places for deceased individuals interred as the painted plaster masked mummies we discussed, housed in coffins that were re-used in a probable attempt to save expense. The upper terrace of the temple that remained free of sand allowed for visitations (Latjar, 2006, pp. 94-95).

Hand scrawled inscriptions began to appear on the walls with the arrival of these people who were more representative of the populace at large including impromptu graffiti and more formal, standardized inscriptions called "dipinti." They indicate the area had become a beacon to visitors, pilgrims and even overnight stays among whom the group of iron-workers are included (Latjar, 1991, pp. 53-54). The inscriptions could also be described by the term *Besucherinschriften*, or visitor's graffiti, that were left behind by individuals who wanted to memorialize their arrivals (Staring, 2010, p. 146). Now let us turn to the subject of who these iron-working pilgrims worshipping upon this rooftop were and what they were doing at this site.

The Iron-workers on the Rooftop of Hatshepsut's Djeser-djeseru: What Were They Doing There?

The two primary researchers responsible for what is currently known about the inscriptions left by visitors to the temple of Hatshepsut are André Bataille, who produced 180 short texts in 1951 in his publication *Les Inscriptions Grèques du Temple de Hatshepsout à Deir el-Bahari*, and Adam Latjar whose subsequent surveys as a member of the second Polish archaeological team to investigate the site recovered an additional 120 Greek inscriptions from 1988-1990 (Latjar, 1991, pp. 53-54).

Latjar's inscriptions are extremely important for this study because they turned up twelve dated texts in the fifty year time period between 283/284 CE to January 26th, 334 CE among which six are positively identified from their content as belonging to a "siderourgoi,"[68] or corporation of iron-workers, who hailed from Hermonthis. Four additional texts were found in the same area— the west wall of the upper terrace— which probably belong to the same group[69] (Latjar, 2006, p. 95).

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[68] "Siderurgos" means "iron-worker," Adam Latjar, personal communication, March 29, 2016.

[69] The first six secure inscriptions are numbers 163-164, 168-169, and 172-173; the second four probable inscriptions are numbers 163, 168-169 and 172 in Latjar, 2006, p. 95.

The Siderourgoi of Armant/Hermonthis—an Average of 12-15 Members

The first two texts that assist us in our quest to know more about these iron-workers are one dated to 324 CE, because it appears to mention fifteen individuals including thirteen who are members of the *siderourgoi* (twelve iron-workers and a secretary), and a second text that mentions thirteen members. Together these texts provide Latjar with the evidence to make the argument that Armant/Hermonthis had an average of 12-15 active professional iron-workers at any time over the fifty year period that they were producing inscriptions at this site (Latjar, 1991, p. 63). Whether or not this is truly all of the iron producers in the region and not just the set size of the group, this represents the very first case in Egyptian history where one can identify such a group of iron-workers, what is more they can be called by their own names.

Let us hear directly from the iron-workers in their own voice. Here we will investigate the following representative text translated by Latjar in great depth because of the questions it raises as well as the information it encodes about these craftsmen. Although the text has a somewhat broken style once we examine it more closely we will see it conveys a lot about them and their cultic activities.

> 1st and 2nd Tybi in the consulship of our masters, the most noble Caesars Crispus and Constantinus, for the third time. We have arrived here …the sacrifice of a donkey, (we) the corporation of iron-workers from Hermonthis, who are listed below: Poumsi son of Askos … archi( ), second archi( ) Penas son of Askos …, third archi( ) Lousios … P ( ) pkoi(sis) brewer … Chollos son of Pasemis, Tyrannos son of Besas, Pesouris son of Phthoi, P( )pekoisos son of Pkoi(sis), Pesouris son of Loulos, Hatres son of Horion son of Thophanes secretary of the corporation, Didymos son of Pabotes, […] Ple(nis) donkey-keeper. The last named slaughtered the donkey before the god and all […] here … made the *proskynema* to the great god. [Latjar, 1991, p. 56]

A *proskynema* is defined by the *Encyclopedia of Ancient History* as an act of devotion that is related to the word *proskynesis* ("kissing toward") which meant prostration indicating submission to a god or its statue (Tallet, 2012 & "Proskynesis," n.d). Latjar argues that in these iron-workers' usage it was a general inscription which cannot offer too many clues about this particular event (2006, p. 97). However, Bagnall and Cribiore report that *proskynema formula*—expressions of this obedience to a god—were popular in pharaonic letters but peaked in Roman letters in the second and third centuries to disappear in the fourth century forward upon the adoption of Christianity. They found a further piece of information that is important. From their study it would appear that the act of performing prostration before the god and leaving a sign was actually an indigenous Egyptian custom that was adopted by the Greeks and not the other way around (2006, p. 89).

Let us further unpack this inscription because when investigated, there is truly an astonishing amount of information provided in this short text from a rooftop, scrawled on a wall of a great temple that was otherwise mired in sand. In Latjar's analysis the pattern seen in this text is similar to the other texts produced by these iron-workers. There is 1) the date, 2) the purpose of the visit 3) the list of the members of the *siderourgoi* and 4) the most important event that took place (Latjar, 2006, p. 96). Following in this order we see that first of all, the dates the group visited were December 27th through 28th 324 CE (Latjar, 1991, p. 56). This is arguably quite important for two reasons: we can tell that they were there for an overnight stay and secondly we can infer that it would have been during a particularly pleasant time of year. This is an area where the typical day's heat climbs to a scorching 106 degrees during the summer (reaching even higher in August). The time of year they chose to visit the temple rooftop was during the coolest month of all, one with days that would include nine hours of sunshine at a nearly ideal 75 degree Fahrenheit high. Nights in this region at this time of year during modern times are typically cool, but not cold ("Luxor Weather," n.d.). Lastly, we see their names and the fact their entire purpose for being there was to make a sacrifice of a donkey before a "great god."

Some of the details begin to impinge upon our goal to know more about the origins of these iron-workers. For Latjar, these iron-workers were clearly Greek speaking, Hellenized Egyptians but he finds many of their traditions to be purposefully evocative of earlier time periods of a purely Egyptian character. For instance, he believes that their sacrifice of a donkey was a very telling decision. He states that it is the "common opinion of modern scholarship [that] the donkey was considered ritually unclean by almost all inhabitants of the Mediterranean area in ancient times including the Egyptians, and as such was not suitable for offering purposes" (2006, p. 97).

Upon closer examination, however, Latjar finds that the donkey sacrifice was actually in accordance with Egyptian tradition. J. Yoyotte found representations of donkey sacrifices in the temples of Edfu and Karnak in honor of Horus of Sile and Sokaris-Osiris who was reborn on Choiak 26th. Mythological papyri showed killing a donkey was a means to extinguish the threats of the guardians of the underworld and the Book of the Dead frequently included donkey sacrifices such as one example where the deceased killed the donkey with a spear. Finally, he notes that Plutarch mentioned a case of the sacrifice of a bound donkey that was hurled from a hill at Koptos (Latjar 2006, p. 97 and footnote 359).

Latjar considers these offerings to fit in with one of the two types paid to the gods throughout the Mediterranean and Egypt. There are the offerings meant to provide sustenance for the gods and then those of another type which are supposed to neutralize evil powers called the "Vernichtungsopfer." These animals were sacred to Seth, the god that represented chaos, and included donkeys along with crocodiles, hippopotami, pigs and oryxes. Sacrificing these animals was thought to be a way of restoring the cosmic order. Latjar considers this to be the most likely ideology behind the donkey sacrifice. For him the fact that the date of the sacrifice occurred in the month after a great festival in honor of Sokaris-Osiris in the month of Choiak is also significant. This festival celebrated the triumph of the god king Osiris over the forces of chaos represented by Seth including a ritual reenactment of Seth's treacherous murder of his brother Osiris, the search for his body by Osiris'sister-wife Isis and the final resurrection of the deceased god king (2006, pp. 98-99).

Latjar makes a further point that is quite important when we look at the cultic practices in the region. He notes that they brought a brewer with them—again a significant point that would be entirely unknown were it not mentioned in this brief but extremely informative text. This is an important point because wine had become the preferred drink of most Egyptians (particularly Hellenized Egyptians) as it was around the Mediterranean world. For Latjar this speaks to their attempts to retain a more ancient Egyptian character (2006, p 102). We might add that it could also simply reflect their non-elite status or the fact that they were paid in everyday goods including beer, bread or grain (Scheel, 1989, p. 60). Nonetheless, it is important to admit that there are some apparent indigenous Egyptian origins to some of the iron-workers' customs.

It is also to be noted that little other evidence remained at the site to speak of the visitors who arrived there. There are several coins that were dropped in the area around the time the iron-workers were visiting, possibly by the iron-workers themselves. Six bronze coins issued between 330 and 348 CE by Constantine the Great and his successors were discovered under the stairs between the Barque Shrine and first sanctuary. A seventh 4th century coin was discovered within the wall that separated the court from the "Room with the Window." These coins were minted in Constantinople, Alexandria, Antiochia, Nicomedia and Rome (2006, pp. 102-103). It is regrettable other objects were not discovered as I shall explain in the following sub-section.

A final point to mention is the character of their corporate group, the *siderourgoi.* Latjar argues that their corporate group was purposefully emulating the earlier Egyptian Ptolemaic and Roman groups that were organized to create communal ties between the members of the organization which included a secretary (scribe) and up to three archi (pp. 102 & 254). They worked together and then celebrated feasts and other events together of which he insists the feast of Choiak-Nechebau was an example (p. 102).

Major Questions about the Iron-workers' Worship

If we recapitulate the large questions that Latjar raises about the inscription cited above it is the following enduring mysteries that he emphasizes which I too wish to answer albeit somewhat differently. Firstly, who was the "great god" to whom the iron-workers were making offerings? Hathor had a presence at the site but the two gods most pilgrims were visiting were Amenhotep son of Hapu and Imhotep. But as we mentioned these were patron deities, supposedly minor gods who had actually lived and experienced an apotheosis. Latjar therefore finds it unlikely that either patron deity was the god to whom they were referring, instead he believes the most likely god that was being provided the offering was the falcon-headed great war god that came to prominence among the Middle Kingdom rulers who built the temples at this site and was sacred at Armant, that god being Montu[70] (pp. 99-100). Secondly, he wonders why they would choose Deir el-Bahari for the place to celebrate the Choiak-Nechebau festival. Deir el-Bahari was twenty kilometers away from their home town, located in a somewhat out of the way cove and was in his estimation, an abandoned temple that lacked a real owner (p. 101). Thirdly and fourthly the choice of beer rather than wine and the donkey sacrifice appear to him to be intentional choices to emphasize their Egyptian, rather than Hellenized roots (pp. 98-99, 102 and footnote 372).

Could the Iron-workers Be at the Site for Another Reason?: The Worship of the Son of Ptah/Hephaistos

In this sub-section I wish to propose an alternate reading of the evidence facilitated by Latjar's groundbreaking discoveries and translations (the new Greco-Roman period inscriptions at Deir el-Bahari, important examples of which include those belonging to the iron-workers' *siderourgoi*) and the highly significant questions and

[70] Adam Latjar, personal communication, "I am inclined to think that they functioned under the patronage of Montu, the patron god of Hermonthis. He is a warrior god, suitable to be the patron of iron-workers. It was suggested that Montu had the epithet 'smith.' This suggestion bases on the popularity of the personal name Plenis, literally 'smith,' on the Theban West-bank, the home of Montu," (Sept. 14, 2013).

mysteries about their religious activities that he emphasizes. Could it be that the iron-workers were worshipping a god that would indeed deserve the epithet “great” to a group of iron-workers?

I suggest that these iron-workers were traveling specifically to *this* temple, and *this* site because rather than lacking a real owner, it housed the very gods that they were worshipping. When the “great god” is either Imhotep or Amenhotep son of Hapu many of the mysteries suddenly disappear. And in fact, there are times when the iron-workers mentioned the “lords” or “gods” that they were worshipping which could mean both Amenhotep son of Hapu and Imhotep were the deities in question. In fact, there is strong evidence that the supposedly humble, once mortal men turned into gods over time were actually thrust into the great pantheon.

Before stating my alternate reading of the evidence, I wish to emphasize the debt to which my view owes to Latjar’s scholarship and demonstrate how closely it actually comports with his line of reasoning. While Latjar ultimately believes another god was being worshipped by the iron-workers, note that he had fully considered the possibility that they were there to worship the patron deities:

> It should be remarked that Amenhotep and Imhotep were excellent candidates for patrons of a professional corporation of iron-workers. Both of them were masters in their professions while living, and Imhotep, while deified, was considered son of Ptah, the divine smith and patron of smiths. Their cult flourished mainly on the Theban West Bank, i.e. the area from which were recruited the members of the Hermonthean corporation of iron-workers.[71] [2006, p. 101]

[71] Latjar examines the issue in 2008 as well, again mostly dismissing Imhotep and Amenhotep but this time coming closer to the idea that Amenhotep is the possible object of worship if he had become a “cosmic god” by this time period (p. 123).

In fact, he goes on to acknowledge the following caveat. The question of who the iron-workers were worshipping "becomes more complicated when we assume that the anonymous 'gods' from the *siderourgoi* were not Amenhotep and Imhotep" (p. 101). I theorize that it was indeed these two gods whom they were worshipping and that when they referred to a "great god" it was more than likely Imhotep who had a strong cult following at the site at the very time the iron-workers were visiting although we shall see Amenhotep cannot be ruled out either and is also a very strong candidate.

Egyptian and Greek Syncretism

I suggest that the god or gods whom the iron-workers were worshipping were on a great cultural "upswing." I believe the evidence is rather clear on the matter and involves several well studied and well established theological processes seen throughout Egyptian history although they have certainly been interpreted in a variety of ways. What is interesting is that the history of the man-turned-god Imhotep was so long—approximately three millennia—that it involves many of these theological processes.

Relatively early in Egyptian history one can see the Egyptians adjusting to new political realities through conflating their polytheistic gods with ones who became newly important to an area through the process known as syncretism. Hans Bonnet was among the first influential voices on this subject. He saw ancient Egyptian syncretism as the process by which one god would be seen as "inhabiting" (*Einwohnung*) another. Other Egyptologists see this as a "fusion," or "identification" of more than one god with one or more others. If one were to look at the god Amun-Re, Bonnet would translate this phrase as one where "Amun is in Re" in such a way that neither god is lost nor subsumed by the other (In Hornung, 1971, p. 91).

Erik Hornung saw syncretisms as a subset of the ancient Egyptians' general ability to *link* more than one god quite purposefully to suit the needs of their particular case. He found that the Egyptians had numerous ways of accomplishing this. Syncretisms were possible, but otherwise Egyptians could also 1) create a kinship situation, for example make one god the spouse, son, sibling, etc. of another, 2) they could state that one god or king was the "image," "manifestation," or *ba* of another or 3) they could develop what Hornung described as "complicated theological statements about the union of two gods," (p. 93). For instance, there are numerous statements in which Re and Osiris are connected to one another: in the Book of the Dead the two gods' names are used interchangeably, in the sixth hour of the Amduat Re is the corpse of Osiris; in a Ramesside tomb the united Re and Osiris appear as a ram headed mummy with a solar disc and in the Coffin Texts Osiris is said to have "appeared as Re." All of this deliberately avoided a syncretism, instead opting for a more complex linkage with what had been a specific theological underpinning behind it. The sun god rises each day in the morning unlinked from Osiris, fully arisen and free from death only to have an image of himself left behind in the underworld until the union could be reenacted at the end of the day again (Hornung, 1971, pp. 93-96, pl. 1 and footnote 111). Among these possibilities, Imhotep would become important to our iron-workers through a family relationship: he became the "son of" the god of craftsmen, Ptah. The fact that he was a famous architect in his own right must have contributed to his standing with other craftspeople.

The arrival of the Greeks caused a multitude of changes that were ultimately absorbed into the Egyptian religion. By at least as the 5th century BCE the Greek traveler Herodotus encountered the Egyptian pantheon and attempted to understand their religion by equating Egyptian deities to their own – the phenomenon known as the *interpretatio Graeca*. The Egyptian god Ptah was known as the creator who spoke the world into existence in the Memphite theology, but he had been a god of artisans much longer.

Imhotep and Amenhotep Son of Hapu at Deir el-Bahari

Imhotep as a "Great God." Imhotep's career in life was almost as impressive as his astonishing 3,000 year career in the afterlife which featured him as a magician, sage and healer. The mortal, living man Imhotep had been the vizier and architect, or "chief of all the works," of the Third Dynasty ruler King Djoser (r. 2780-2761 BCE). In this capacity Imhotep astounded his contemporaries by producing the step pyramid at Sakkara, the first pyramid in all of Egypt and the first free standing stone structure in the region, if not the world. Yet later Egyptians remembered him for other reasons, one of which was imparting wisdom. Although no documents from his hand or voicing his proverbs survive, the "Harper's Song"[72] tells us that the words of Imhotep lasted thousands of years after his tomb was lost (Turnure, 1952, pp. 25-28).

> I have heard the words of Imhotep and Hardedef,
> Whose maxims are repeated intact as proverbs.
> But what of their places?
> Their walls are in ruins,
> And their places are no more,
> As if they had never existed. [Simpson, 2003, 332]

[72] A copy of earlier texts from the New Kingdom that originated in the chapel walls of one of the Middle Kingdom or Second Intermediate Period rulers named Intef of the 11th or 17th Dynasty (Simpson, 2003, 332 and footnote 35).

In spite of the fact that Imhotep's tomb disappeared in antiquity numerous votive statues dedicated to him at shrines and temples attest to the fact that he was already viewed as a semi-divine figure by the Fourth Dynasty (c. 2543-2436) [Turnure, 1952, p. 27].

At the onset of the Persian period in 525 BCE the next significant change occurred in Imhotep's status – one that would correspond to a few of Hornung's characterization of syncretisms. Imhotep became fully deified and incorporated into the theology of Memphis by becoming a key member of their great triad. The previous triad had been comprised of the creator god in the Memphite theology, Ptah, his wife Sekhmet and their son Nefertem. At this time Nefertem was summarily replaced by Imhotep who was thereby elevated to the status of a fully divine god by entering into a familial relationship with one of the most important deities. Suddenly, Imhotep was none other than the "son of Ptah." [Turnure, 1952, pp. 27-28]

During the Ptolemaic period (332-30 BCE) the Greeks began to emphasize Imhotep's role in the healing arts and at first they identified him with their god of medicine Asklepios. The great temple at Philae was built in the Ptolemaic period centuries before the arrival of the iron-workers and the *Djeser-djeseru* at Deir el-Bahari appears to have changed its primary function. During the reign of Ptolemy Euergetes II the sanctuary that led from the west wall of the upper court was increased by a third chamber where Imhotep/Asklepios and Amenhotep son of Hapu were featured prominently. [Milne, 1914, pp. 96 & 98]

One of the key questions that we saw raised was whether or not Imhotep would be a candidate for the "great god" mentioned. In 1914 J. Grafton Milne published a short study of "The Sanatorium of Dêr-el-Baḥri [Deir el-Bahari]" where he noted several "stock formulae" at the site, one was a person coming to pay homage to Asklepios who would write: "the homage of M. to the lord god Asklepios," and the other stock phrase—highly significant for this study— was "N. came to worship the *great god* Asklepios" (emphasis mine) which was usually added to Amenothes/Amenhotep (p. 97).

In 1977 Dietrich Wildung produced the seminal study, *Egyptian Saints: Deification in Pharaonic Egypt* which provided a sustained argument that showed that both Imhotep and Amenhotep son of Hapu had been brought into the Egyptian pantheon and specifically were elevated to the status of "great gods." Wildung noted how extraordinary this was because even the kings of Egypt were "inferior to the great gods of the pantheon" which was actually part of the reason the common people were able to relate to them (p. 28). Even the king's iconography was limited, when desiring to show his divinity the king could never take the shape of an existing great god (p. 27). Therefore, it was all the more astonishing that Imhotep's millennia long apotheosis ultimately allowed him to meld the long apron of a priest, papyrus of a wise man and *the cap that was the sign of Ptah himself*, his divine father, into his own iconography (p. 43). Not even a king of Egypt would normally achieve such a distinction, which makes Imhotep "great" indeed. By the New Kingdom Imhotep was the son of Ptah (p. 35) and by the Thirtieth Dynasty (c. 380-343 BCE) he was depicted as a full member of the great pantheon of Memphis (p. 43).

Lest we be assured that a "great god" at Hatshepsut's temple at Deir el-Bahari could only be Imhotep, there is another god to consider. Amenhotep son of Hapu began being worshipped in earnest there in the second century BCE and in a document dating from the reign of Ptolemy VI he was referred to as a "great god" for the first time (p. 95). He too was considered a sage and healer but Wildung notes that when he is referenced in relation to Osiris, Osiris addresses Amenhotep in a "familiar" way making him appear "not *so* great" as the highest members of the pantheon (pp. 95-96). Nonetheless, he was accepted into the great pantheon and when the two gods appear together Imhotep is normally *subordinate* to Amenhotep son of Hapu. Wildung only found two instances where they were treated as equals (pp. 103-104). It is clear then that Amenhotep son of Hapu too would be attractive to craftspeople and iron-workers alike. In fact his priesthood was often comprised of simple craftsmen who served in the temple guilds (p. 90). Furthermore, in the second century CE we find there was an association that operated in the neighborhood of Thebes for the purpose of worshipping Amenothes/Amenhotep so we cannot rule him out as *the* "great god" of the iron-workers of the later period (Nock, 1972, p. 431). Nonetheless, I would like to explore the possibility it was Imhotep since the evidence has yet to be amassed.

The Question of Hephaistos/Hephaestus: The Greek Ironworking God Syncretized with Imhotep

Could the iron-workers have been at Deir el-Bahari to worship Imhotep in one of his most famous syncretic guises as the "son of Hephaistos?"

> Hephaestus we are told, was the discoverer of every manner of working with iron and copper and gold and silver and everything else which

> requires fire working, and he also discovered all the other uses to be made of fire and turned them over both to the workers in the crafts and to all the other men as well.
>
> Consequently the workmen who are skilled in these crafts offer up prayers and sacrifices to this god before all others, and both they and all mankind as well call the fire "Hephaestus," handing down in this way to eternal embrace and honour the benefaction which was bestowed in the beginning upon man's social life. (Diodorus of Sicily. V. 74, 2-3)

Diodorus of Sicily makes it clear that Hephaistos was a god that circum-Mediterranean iron-workers knew, worshipped and considered a major benefactor because he discovered everything related to working with fire and that their method of worship was through sacrifice, which is what we saw the iron-workers doing on the temple rooftop. This is notable because as we demonstrated in the historical section, after the 6th century BCE iron was being smelted in Egypt in appreciable amounts and may have been extracted from Egyptian ores as well.

During one of Hephaistos' most famous episodes he is associated with a donkey, the very same unusual choice of animal the iron-workers used for their sacrifices. In the *Iliad* and the Greek-speaking Roman rhetorician Libanios' version Hephaistos tells the tale of his banishment from Olympus by his own mother Hera because he was afflicted with a clubbed foot. Hephaistos retaliated with the clever ruse of sending a throne to Hera which trapped her in its invisible bonds which forced the Olympians to try to convince him to return in order to free her. Ultimately the lowly god Dinonysus completed the task by plying Hephaistos with drink and bringing him back on a humble donkey to much fanfare (contrasted to the magnificent chariots and steeds typical of the Olympians). Since the iron-workers visiting Deir el-Bahari had a live donkey with a donkey handler it is clear they had a procession to the temple before the sacrifice which is an enticing similarity to this episode which is immortalized in art as the "Return of Hephaistos" motif. [Hedreen, 2004, 38-39 and 41]

There are other pieces of circumstantial evidence that potentially corroborate this theory. Suzanne Lewis notes that of all the Greek papyri to have been discovered in Egypt, several hundred fragments belong to Homer's *Iliad*, demonstrating its enduring popularity. "That the first literary papyrus to be found should be a partial manuscript of the *Iliad* was a fortuitous but symbolic harbinger of the preponderance of Homeric texts to follow" (Lewis, 1973, p. 309).

Furthermore, there is the recent work concerning the households of Roman Egypt. By the Roman era (30 BC-395 CE) Boozer notes that there was a powerful overlay of Greek society in place across all of Egypt in terms of language, forms of administration and legal systems. The Romans did not encourage immigration the way the Ptolemies had so that Hellenism continued to be the way that one symbolized an alliance with Roman rule, particularly in an elite household. Although Boozer expects that different segments of the society and different households would have had varying responses to Roman rule, her very rare look at elite Roman households that were contemporaneous with the iron-workers' cult activities, located at the very furthest extent of Roman influence in Amheida (ancient Trimithis) in the Dakhleh oasis, provide clear knowledge of the god Hephaistos.

The core of the very wealthy 3rd to mid 4th century home of a city councilor named Serenos contains ostentatious paintings devoted to famous moments in Homeric mythology. In one of these paintings Hephaistos is displayed catching his wife Aphrodite and the god Ares in the act of adultery. He ensnares them in an invisible net as a group of gods is allowed to watch so that her affair might be made known (see Appendix B, Figure 12). Again Hephaistos is rejected and humiliated, yet again he finds a clever way to gain what we might call "retributive justice." His adulterous wife's indiscretion is made public. Thus at the very furthest reaches of the Roman Empire in Egypt at the same time the group of iron-workers were active in Armant, the domestic sphere of a wealthy person used the image of Hephaistos himself to assert and bolster the household's elite status.   [Boozer, 2010, pp. 143-151]

Of course, Imhotep is not identified with Hephaistos himself, he is specifically considered to be a "son of Hephaistos" through the processes of syncretism. In the circum-Greek world this still provided an avenue of worship. Among the Greeks and pre-Greek cultures in areas they colonized, Susan Cole has established that the term "gods" (*Theoi*) or "great gods" (*Theoi Megaloi*) were used by many worshippers for gods whose names should not be mentioned (in Blakely, 2012, pp. 55 & 61).

In one case these "Great Gods" are quite familiar. In the three intervisible islands[73] of Samothrace, Imbros and Lemnos the "Great Gods" of their mystery cults were *daimones* (divine beings less powerful than Olympians but more powerful than mortals) called the *Kabeiroi* (p. 55 & 2013, p. 158). The *Kabeiroi* were the object of secret rites that were highly associated with iron-smithing and could also be appealed to for protection at sea. Blakely notes that the *Kabeiroi* "vary in form from one site to

[73] These are three islands located in the northern Aegean close enough that they can be seen from one another with the naked eye presumably aiding travel between them.

another, assuming the form for the followers of the dominant male deity wherever they appear." On Imbros they were sons of Hermes whereas on Lemnos they were sons and attendants of Hephaistos who landed on the island after Hephaistos was cast down from Olympus by his mother (2012, p. 55). Worshipping the *Kabeiroi* conferred social status and protection. The tokens of these rites were magnetic iron rings according to literary sources and some corroded examples were discovered archaeologically. Apparently the magnetism of the iron was interpreted as being quite special. The ability of these iron rings to display the properties of attraction and other forms of movement including leaping "as if [they] wished to flee" appear to have been considered magical and extraordinary to the ancients which would have helped to spread the fame of this cult and these islands far and wide (2012, p. 61).

These three Thracian islands were part of greatly interconnected economies, widespread trade routes and were highly associated with both militarism and the metallurgical skills of their inhabitants—particularly in iron (2013, pp. 158-159). Therefore, one wonders if knowledge of their rites spread via the iron-workers reputed to have been Greek mercenaries, merchants (or other Greeks) who may have brought knowledge of this craft to Egyptian sites like Naukratis. While this route remains speculative, it is an established fact that the Ptolemies patronized the mysteries of Samothrace which was partly responsible for the increasing internationalization of that site and its significance (Nock, 1972, p. 58). The god Imhotep's identity as a son of Hephaistos would make him an ideal object of mystery rites to anyone familiar with the Thracian tradition. It is also one of the examples that in the Greek tradition worshipping non-Olympians as “great gods” was quite an acceptable practice. The demonstrable malleability of the *daimones*’ cult in fitting different genealogies on different islands also makes this conceivable.

At another Aegean island, Samos, 132 Egyptian bronzes were found in the sanctuary of Hera. Since no known Egyptians ever traveled there but Samians were known to have visited Naukratis regularly it is believed Samian merchants brought them back to the island after visiting Egypt (Snodgrass, 2006, pp. 230-231). Obviously metal was making its way between Greece and Egypt and being brought to an important religious site, no less. While we only have this indirect evidence to inform us it does demonstrate that there was intercourse between the areas and that the merchants acting as the go-betweens were familiar with the religious rites of the Aegean.

At Deir el-Bahari all sixteen known cases where Imhotep’s name is mentioned in Greek, it is always as “Asklepios,” the Greek god of medicine who was also the “son of Hephaistos” (Latjar, 2006, p. 12 & 47). Nonetheless, in one poetic text (number 100) that may be a hymn he is referred to as the “son of Phoibos/Apollo” which is also quoted in a second text (208) (p. 47) so that we must exercise some caution in our interpretation of the identity of Imhotep.

Another caveat with my interpretation is that I have been unable to locate any artifacts known to be associated with the worship of the *Kabeiroi* at Deir el-Bahari. Some iron rings have been located in association with the mysteries of the *Kabeiroi* in the Thracian islands and so far have not appeared at Deir el-Bahari, but one must remember that these would be highly valuable objects that would never be left behind on purpose.

Furthermore, one could certainly worship the son of Hephaistos in a manner that did not include the rings or Thracian rites and again, we can establish that people with knowledge of Aegean religion were traveling regularly to the Nile Delta.

The Healing Ostracon: Teos son of Psenamunis and the Iron Snake Bracelet

There is one text that is especially intriguing in this context: a demotic ostracon that is believed to belong to the Deir el-Bahari corpus. In the text an individual named Teos son of Psenamunis was provided a diagnosis of a fever by Amenhotep. The cure that the god presented him was that he was to drink the juice of two Syrian figs, and eat a mixture of the figs with bread while wearing a snake of iron on his arm—presumably a bracelet— that was given to him by Amenhotep. Latjar believes the snake of iron could have referred to either the snake goddess Mereseger, who was important in the region, or Asklepios (2006, pp. 54). He doubts the fact that it was made of iron lacked significance and notes that Egyptian medical texts considered iron to be useful for driving away ghosts and demons of illness (p. 55). The mention of iron in this ostracon offers us many interesting possibilities. If the iron was associated with driving away demonic forces then the metal was viewed in a similar fashion as the Thracian rings whose magnetism was seen as an animating force associated with the power of the *daimones*. If the snake iron bracelet did refer to Asklepios—reminiscent of the Rod or Staff of Asklepios which is a snake-entwined rod associated with healing—then we must ask could this be a nod to his coinhabitant of the temple's identity as the son of the iron working god Hephaistos? If none of these is the case, could Amenhotep himself have had a relationship to iron? In all of the textual evidence from the visitors to the site, it is Amenhotep who appears to be the temple's main inhabitant. Perhaps he had his own as-yet-unknown relationship to iron and by extension iron-workers, certainly an idea that is within the realm of possibility because of his known associations with craftsmanship and working people. Without further evidence to elucidate which one of these possibilities, if any, is the strongest I find myself most intrigued by the similarity to the relationship between iron jewelry and the *Kaberoi*, the *daimones* who were worshipped in the Thracian sea among whom were included the sons of Hephaistos. After all, the rod of Asklepios is even known to this day as a symbol of Western medicine so it was certainly a powerful, evocative and astoundingly enduring image.

I believe that the most likely scenario is that the iron-workers were worshipping Amenhotep son of Hapu and Imhotep, probably as Asklepios since that is by far his most common identification there. The iron-workers traveled up to twenty kilometers regularly and quite purposefully to visit patron deities who had achieved "great god" status as Wildung and Milne have convincingly demonstrated and both gods were closely associated with workers. There is also the similarity of the relationship between iron jewelry and the *Kaberoi*, the *daimones* who were worshipped in the Thracian sea among whom were included the sons of Hephaistos. In addition it is highly significant that we can establish that the iron-workers stayed overnight for feasting and drinking because this entirely fits the oracular nature of the gods.

The alternate theory is that the god in question was Montu which is based on the iron-workers' theophoric names which translate to meaning "smith." If we examine this idea closer, however, we must acknowledge that this name actually comports much closer with the identities of the patron deities Imhotep and Amenhotep son of Hapu who were actually housed at the temple. Both were associated with craftsmen, and there is even one disputed text possibly written by the iron-workers that does actually name these two gods. Latjar also acknowledges that in the Demotic letter of Osoroeris to Amenhotep son of Hapu he is specifically called *pꜣ ntr ꜥꜣ* ("the great god"). This same designation is used for Amenhotep son of Hapu in the titles of three of his priests, Amenothes son of Horos, Harpaesis and Amenothes son of Thotsytmis (2006, pp. 21 & 25). Thus, the strongest case for the "great god" not being a patron deity really is removed altogether.

I consider it within the realm of possibility that Asklepios/Imhotep was significant to the iron-workers because of his guise as the "son of Hephaistos" although it must be admitted that only circumstantial evidence can be amassed to support this claim at the present time. Nonetheless, it is useful to offer this possibility so that it can be considered when future studies of this corpus are undertaken and should any iron rings or other tokens be discovered. The presence of a donkey and its apparent use in a pilgrimage is also probably significant and is reminiscent of the famous "Return of Hephaistos" episode. As we have noted in the one case where a curious iron object is mentioned in the texts that are probably from Deir el-Bahari it is in the form of an iron snake which may refer to Asklepios/Imhotep or Mereseger (Latjar, 2006, p. 54). Future discoveries, of course, may either refute or corroborate this hypothesis about the identity of the "great god."

For this dissertation, however, the most salient point is that we can say something about the cultural admixture of the iron-workers' belief system and identities. What we do know is that the iron-workers overall were living and worshipping in a manner that showed a demonstrable mix of indigenous Egyptian and Greek influenced customs and naming practices. Their names were Greek, their writing was Greek, their guild was modeled after Ptolemaic (or Roman) models but their cultic rites seem to have a deeply indigenous Egyptian character to them although they may have possessed the *sheen* of Greek overlays. The god whom they were worshipping (regardless of identity) and the manner in which they were worshipping that god were rooted in thousands of years of Egyptian history.

The choice of temple and their regular visitations were in all likelihood purposeful since they were repeated. It is my view that the god in question was a long term inhabitant of the temple corroborated by the fact that so many other pilgrims had visited this site for centuries. According to Bagnall and Cribiore the *proskynema* was actually an indigenous form that the Greeks borrowed. But were these iron-workers aware of the indigenous nature of their god and worship? There *does* exist a possibility that *even* some of the indigenous Egyptian elements to the iron-workers cultic practices were ones that the iron-workers believed were more Greek in nature. They could very well have been associating Imhotep with a Greek guise – Asklepios, the son of Hephaistos — and we do know that the Greeks were using the *proskynema* formulae. Therefore, these iron-workers very clearly display an interesting hybrid of Egyptian and Greek characteristics where some of the Greek characteristics are carefully cultivated like the key central choice: to worship together as a worker's guild in a style that probably originated under the Ptolemies.

As we demonstrated in the historical section, iron of this time had been a utilitarian metal possibly since the Old Kingdom (with very few ambiguous examples) [c.2543-2120 BCE] before appearing frequently for the first time by the Late Period (c. 722-332 BCE). Yet Egyptian magical texts and Roman era (30 BC-395 CE) texts indicate that even an iron nail could have quasi-magical or "medical" properties and the iron-workers whom we just encountered mixed their work life and religious life together rather seamlessly. The modern view of iron as an industrial metal indicative of a great technological advance does not comport with the ancients' experience. Even when we see them using iron more frequently for utilitarian purposes their ideas were shaped by a radically different worldview which could include magical and religious associations. At every stage I would additionally argue that the basic attitudes toward the metal are oriented more towards the outside world than indigenous ancient Egyptian customs or social structures.

Since we established that Egypt appeared to have curiously left the Iron Age after the Roman period I would like to briefly mention the historical circumstances that contributed before we turn to the conclusion. Why did the iron-workers disappear from history and what could have caused the disruption in iron production?

The Remarkable Times in which the Iron-workers Lived: The Crisis of the Third Century and its Aftermath

What is particularly interesting about these iron-workers is just how tumultuous the conditions surrounding them actually were. We know they were active in the fifty year period between 283/284 CE to January 26th, 334 CE which was just following the time when the Roman Empire actually was near complete and total implosion. In the fifty years prior to the iron-workers' first inscriptions, a Roman emperor by the name of Severus Alexander had been murdered. This began a period when the Roman Empire became vulnerable to their east by endless wars with the Sassanid dynasty of Persia, "barbarians" to the north, massive inflation, rebellions and a series of soldiers who were elevated to the status of emperor by their armies only to be assassinated within a few years of chaotic rule. In the years between 235 and 285 the Roman Empire had an *astonishing twenty-two emperors of whom only one escaped with his life* (Dunstan, 2011, p. 412).

One of the most salient results of this chaos was that in order to maintain the Roman legions taxes rose. In this particular case, it was accompanied by a reduction in the number of people to work the mines. This combination of an increased need for coinage and less being available caused the wealthy to begin hoarding coins for their precious metals (Dunstan, 2011, p. 413). In my view this dynamic was every bit as important to the disruptions in iron-working in Egypt as any other factors.

At the conclusion of the third century this upheaval reached Egypt directly when the aforementioned Blemmyes began to make successful incursions again and a shadowy figure named Lucius Domitius Domitianus attempted to seize control of the Roman Empire through a revolt that included many cities throughout Egypt beginning around July 297. The emperor Diocletian was able to suppress the rebellion but the Alexandrians appear to have been extraordinarily tough holdouts and it was only the capture of the city by Diocletian in the spring of 298 that ended this episode. The entire experience compelled Diocletian to separate Egypt into three provinces, Jovia, Herculia, and the Thebaid. Egypt was forced to accept new imperial coinage which had an enormous economic impact proved by the fact that it ended their own native coinage in ancient times. As we saw some of the new coins were dropped at Deir el-Bahari contemporary to the iron-workers' visitations. In 301-302 a Roman legion (or at least part of a legion) was also set up in Thebes at the temple of Luxor—not far from Deir el-Bahari. What is more, Diocletian began to pay tribute to the Blemmyes suggesting they had been a formidable foe during the first fifteen years the iron-workers were actively recording their pilgrimages, and one that was relatively close to their southern border. [Vandorpe, 1995, p. 236; Johnson, 1950, pp. 13-21]

Diocletian's many reforms across all of the Roman Empire were enough to stabilize and secure its existence for another century before new troubles (and he retired of his own volition and died at his own home, an accomplishment in itself at this time). The arrival of Christianity may have contributed to the end of their cult worship as has been argued. However, since iron (and bronze) production dropped at the same time it is clear that larger forces were at work. The serious country-wide revolts on a "civil war" level, the formidable incursions of the Blemmyes, a new economic and administrative reordering of the entire country and finally a strong Roman military presence bent on imposing order ultimately contributed to changing the course of the history of iron throughout ancient Egypt. And in fact, what we see is that iron ultimately became much less important than it had been. It is my view that this is also partially attributable to the fact that it had never become overly important to the ancient Egyptians' socio-cultural worldview.

Conclusions

This dissertation has sought to establish the chronology of the ancient Egyptian Iron Age as well as argue that in addition to technological constraints there were socio-cultural reasons behind the peculiar historical trajectory to ancient Egyptian iron use. This has been meant to offer a corrective to previous theories that have primarily sought functionalist explanations and neglected to describe the nature of ancient Egyptian iron use. For instance, Coghlan argues that Egypt's copper and bronze were sufficient for their needs, their iron ores may have not been easily extracted and worked and that even though Spanish ores were available for transport by sea by the Roman era they had to be hot-forged and worked with the shafted hammer which the Egyptians did not like (1977, p. 43).

Some of these facts are probably true, especially the sufficiency of copper and bronze, but this argument neglects to describe and explain the escalation of iron use under Roman rule or the overall history of its use. I have sought to demonstrate that the ancient Egyptians did not appear to have any particular aversion to the heat-treatment of metals (and there is an argument that they heat treated iron as early as the Predynastic c. 3300 BCE), that their metallurgical skills either kept pace with every other region or were capable of doing so, that they may have been able to produce utilitarian iron tools by the Bronze Age (although perhaps not to the industrial degree allowed by a significant smelting technology) and that they had some organized members of an ironworking profession in the Greco-Roman era as well as a great escalation of iron production at this time. That is to say, they were always capable of producing iron but did not develop an interest in doing so as early as some of their neighbors.

It is likely that iron ores were more readily available under the Romans before the Third Century Crisis, however, I also believe that one of the deciding factors to the trajectory of iron use was the Egyptians' own relationship to the metal. It does not appear to have been particularly important to them at any point and when it did increase in its prestige value, become part of a recognizable smelting technology organized into a larger "industrial" sector (in ancient terms), or become part of an organized profession it was evidently because of foreign influence. Outside attitudes towards the metal appear to have filtered down to the indigenous Egyptians at various points but never to the degree they did in other cultures.

No one has established the chronology of the Egyptian Iron Age with any specificity until now. Several proposed dates for its inception have included the 6th century BCE, the New Kingdom (c. 1539-1077 BCE) as a "Sporadic Iron Age" according to Petrie and the Old Kingdom (c. 2543-2120 BCE) by early Egyptologists with the notable exception of Rhind. We had already established that the Old Kingdom date for an Iron Age was no doubt erroneous, although it was still a subject of argument in the Lucas & Harris publication *Ancient Egyptian Materials and Industries* of 1989. We then began with an overview of the evidence to date and an analysis of the material within museum collections in accordance with Snodgrass's tripartite scheme for determining the chronology and transition points of the ancient Egyptian Iron Age. From reviewing the evidence, I had believed there was also a time when the Egyptians began producing *less* iron as well. I wanted to determine if there was a demonstrable time period when the Egyptians *exited* the Iron Age.

In 2014- 2015 I surveyed sixty-five museums across the globe which included all museums with substantial ancient Egyptian collections. This provided a list of fourteen museums with catalogues that included iron objects with the necessary dates, function and provenance in ancient Egypt within the traditional boundaries north of Aswan necessary to determine when Egypt's Iron Age occurred. After dividing the resulting 901 pieces of iron by date, function and provenance I found that there was initially very little iron up until the Late Period (c. 715-332 BCE) when there was a first peak and fall in use, followed by a much larger increase in iron use in the Roman era (c. 30 BC-395 CE) after which its use fell drastically. Iron use continued and never entirely ended— the British Museum alone has 34 Coptic iron objects— but the use did dwindle significantly. Since iron use never outpaced bronze after bronze came into use, the ancient Egyptian Iron Age was at best a subdued phenomena whose peak was in the Roman era. The introduction of the smelting technology in the Delta in the 6th century BCE, nonetheless, remains a significant turning point.

It must be re-stated that the stone-bronze-iron tripartite scheme is most useful in parts of continental Eurasia. The Americas and Pacific are lacking in a Bronze Age and Iron Age (Bentley & Ziegler, 2011, chapter 20) with the majority of the Pacific islands and Australia remaining quite content without the use of any metals until the modern era. In the case of the Pacific even the few examples of metal use were objects traded for with Europeans in the historical era as shells, stone and vegetal materials perfectly suited their needs in the more distant past (Bentley & Ziegler, 2011, pp. 427-433). North African chronologies do not match Europe in prehistory and sub-Saharan Africa is its own unique case that did not include a Bronze Age. As we noted earlier, Japan's "Yayoi Revolution" saw an arrival of bronze, iron and agriculture all around the third century BCE (Craig et al., 2011, p. 262). Nonetheless, the tripartite scheme has some utility for organizing objects in its limited geographical area and does help us think about the relationships these cultures had with one another. The tripartite scheme is not a ubiquitous pattern of ages as once conceived, it is more a relic of historical processes that tells about the movements and technology transfers between bronze and iron-using peoples and other populations in continental Eurasia. For this reason I did find it a very useful tool for this particular project.

One of the reasons Egypt provides us such an interesting case study is because they were such early adopters of small quantities of iron but then failed to reach peak use until *millennia* later which is quite unique. We established that at present the very first known worked iron in the world comes from Egypt in the form of beads found in rather interesting Predynastic burials, one of which includes a severed head. I believe this manner of burial was actually an indication of the power of the person interred or was some otherwise desirable form of burial. The second burial may have been an individual with a "specialist knowledge" of distant realms which was established on the basis of the wide geographic range from which the burial goods derived.

By the Old Kingdom (c. 2543-2120 BCE) iron was associated with the vault of the heavens, the king's body upon apotheosis, the king's throne and some other magical or godly implements. Although it was not until the New Kingdom (c. 1539-1077 BCE) that the epithet *biꜣ n pt* “iron of the sky/heavens” appeared it does seem quite likely that the Egyptians associated iron with stars (and perhaps meteorites) by the First Intermediate period (c.2118-1980 BCE), based upon linguistic evidence. The iron itself was evidently meteoric at this early date. These facts, we noted, were our first indication that iron had an “otherworldly” or “outside” orientation to the ancient Egyptians. In contrast to the arguments of early Egyptologists, we can say iron certainly was *not* used regularly or deeply integrated into the fabric of their society by the Old Kingdom.

Egypt not only escaped the Iron Age for three millennia after its initial use, it also managed to escape this new metallurgical stage six centuries after many other areas of the Eastern Mediterranean with which it had quite a lot of contact during the Bronze Age and even well before. In the Late Bronze Age the seeds of the Iron Age were laid as iron producers in many lands began producing objects that had practical functions. Even many “prestige goods” had utilitarian forms including blades and javelins.

It is interesting that around 1200-1100 BCE the post of Beth Pelet on Egypt’s very frontier revealed iron was common in the “utilitarian” forms of hoes, picks, adzes and ploughs. Forbes notes there was one pick alone that was an astonishing 7 pounds (Forbes, 1964, p. 433). Ultimately, however, the Iron Age would reach the areas that were most transformed during the Bronze Age Collapse c. 1200 BCE. In my estimation, Egypt’s socio-cultural continuity was probably the deciding reason it would escape larger scale smelted iron production for six more centuries. On the surface this idea is somewhat similar to those scholars who have argued that Egypt’s “isolation” and cultural conservatism were reasons that they never became major iron producers but my emphasis is more on the specific relationship between iron producers and users. I believe the fact that Egypt was not as greatly affected at the end of the Bronze Age to the degree so many other areas were was a deciding factor. In addition, Egypt did not become subject to such a different socio-political order with so many new webs of relations between metal producers and consumers as has been postulated for other regions like the Levant.

I argued that Egypt's unique place among the Great Powers at the end of the Bronze Age where it did not endure the same levels of destruction of its societal structure and where the same power centers including the temples and kingship survived (albeit in competition with one another) actually kept it from entering the Iron Age until many centuries later and even then it was in a more subdued fashion. The enhancement of iron's prestige value probably occurred because of its place in the international relations of the time although the fact that some of these prestige goods took utilitarian forms would presage its future uses.

Smelted iron did not show up in great quantity in Egypt until the 6th century BCE in Naukratis and Defenneh although some emphasize the fact that the Assyrian collection was earlier (Coghlan, 1977, p 42). Here I would note that in both cases, we probably have foreign incursions. The smelting facilities are believed by most to be Greek derived (which I did not dispute, at present I believe it is the most likely case) and the Assyrian helmet in the so-called Assyrian collection again argues for a probable outside intrusion.

The Roman era (30 BCE-395 CE) would see the greatest fluorescence of ironwork in ancient Egypt complete with the first real evidence for an ironworking organization although very little is truly known about them. There are many clues that the iron-workers could have been indigenous Egyptians including the fact that they were drinking beer and sacrificing a donkey (both unlikely for Greeks). Nonetheless, they were demonstrably Greek influenced. They had Greek names, wrote in Greek and were organized in a society that was probably Ptolemaic in form. I believe and argued that the identity of the "great god" whom they were worshipping was probably an inhabitant of the temple to which they went out of their way to make a pilgrimage with a living donkey. I suggest it may have been Amenhotep (who was called a "great god" and was associated with workers) but was just as likely if not more likely to be another being who had the same epithet, Imhotep in a Greek guise, namely Asklepios. Asklepios notably was a "son of Hephaistos," the Greek god of volcanism, smithing and iron. Whether my interpretation is true or not, it is inescapable that the iron-workers were Greek influenced, more than likely indigenous Egyptians who were Hellenized (the only other real possibility being they were Greeks who were influenced by millennia old Egyptian traditions). I argued that greater access to iron ores were probably a very important factor in the Roman era but that the influence of Greco-Roman attitudes towards iron and concomitant new construction methods probably influenced its heightened use as well.

In the end, ironworking in Egypt would begin to taper off by the Late Roman period, most likely as a result of the great number of changes that occurred throughout the Roman Empire and Egypt at that time. At every stage of iron's use technological constraints were further influenced by socio-cultural attitudes whose changes over time were often instigated by outside influences. This, in my view, is why ancient Egyptian iron use took its completely unique historical trajectory.

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Appendix

Appendix A: A Tool for Historical Study, Why One Should Expect to be Able to Recover Ancient Technologies

I offer the hypothesis that there is a broad tendency in the technological advancement of most if not all societies to continue practicing outmoded technologies in lower frequencies even when the majority of people have moved on to the newer ones. If we were to consider a modern analogy, the invention of e-books and PDF's have been predicted to presage the end of paper based books the way paper based books replaced manuscripts. If this hypothesis is correct, paper based book making technology will never entirely cease. Even if merely for the purpose of nostalgia, prestige for an ancient and historical form of knowledge preservation or because certain regions of the world cannot afford the newer digital books and continue the older production methods for economic reasons I would predict we will continue to see this technology continue indefinitely.

I would further suggest that while members of a culture do not really know why this occurs and would offer infinite reasons for maintaining an outmoded technology if asked there is an actual sociological principle at work here: survival. This small but significant strain of cultural/technological conservatism has an evolutionary advantage: one never knows when a new technology could become disadvantageous. To have some members of a society still practicing an older, long-lived, once-useful technology means it is always available to return if necessary. Later on it may even develop newly discovered advantages. Maintaining knowledge in the cultural storehouse is an "insurance policy" in an uncertain world where multiple technological options can be important and often life-saving. This was probably more true for ancient cultures with lower populations and less ability to survive calamity.

How does this translate to iron use? It is useful for anthropologists because one often *can* find some way of reconstructing technologies that have seemingly long disappeared. There may be myths, secret guilds, nostalgic societies, people living in an older style further away from the larger population or any number of means by which to reconstruct the technology. In fact, I venture to argue this is true for many other aspects of culture as well as first described by E.B. Tylor in his notion of the "irrational" practices or aspects of culture that are the vestiges of previous traits known as the "survival" (1871). In a slightly different but related vein, pediatricians have recently begun recommending the ancient practice of swaddling upon finding it actually helps infants fall asleep faster and sleep longer in the first three months or so of life causing its resurgence in Europe and North America after having only survived in less developed economies ("Swaddling," n.d.). The practice may have lasted for millennia in Egypt which I would argue often means it has a wide variety of application, again, meaning a resurgence is possible or even potentially helpful at any time.

I would argue that one should actually operate with the *expectation* that there is some way in which an ancient technology can be recovered from a culture. This has been used in Africa to great effect as we see in this dissertation (in the section about the Bantu) since much of the ironworking production methods were able to be reproduced for recording on film and written descriptions in spite of the fact they were thought to have died out. Elsewhere in the world the Polynesian voyaging technology completely disappeared from the archaeological record but was reconstructed with the help of one Micronesian navigator who realized he was one of the last people who knew the ancient methods. Likewise, there was no period in ancient Egypt when iron completely fell out of use (see Appendix C).

Appendix B

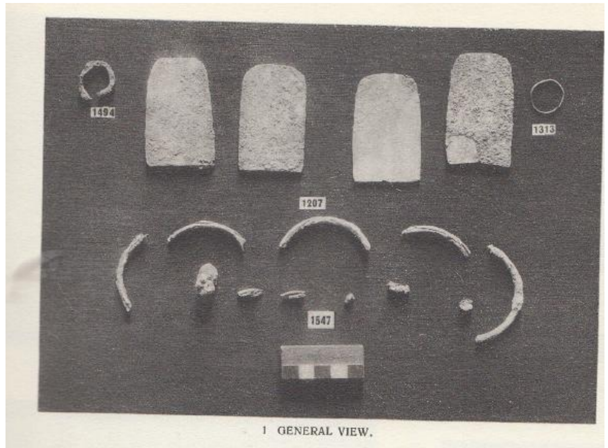


Figure 1: The surviving image of a heavily oxidized ring from the cemetery at Armant appears in the upper left. It may have been of Predynastic date, contemporary with two copper bangles. It disappeared on its way to being analyzed and therefore whether or not it was meteoric or smelted is unknown (Mond & Myers, 1937, PL XLIII).

Figure 2: 7th Century BCE iron tools found in association with a bronze, Assyrian style helmet, missing trumpet and bronze bowl. The tools are *not* characteristically Egyptian in appearance. (Petrie, 1897, pp. 18-19 and Plate XX I).

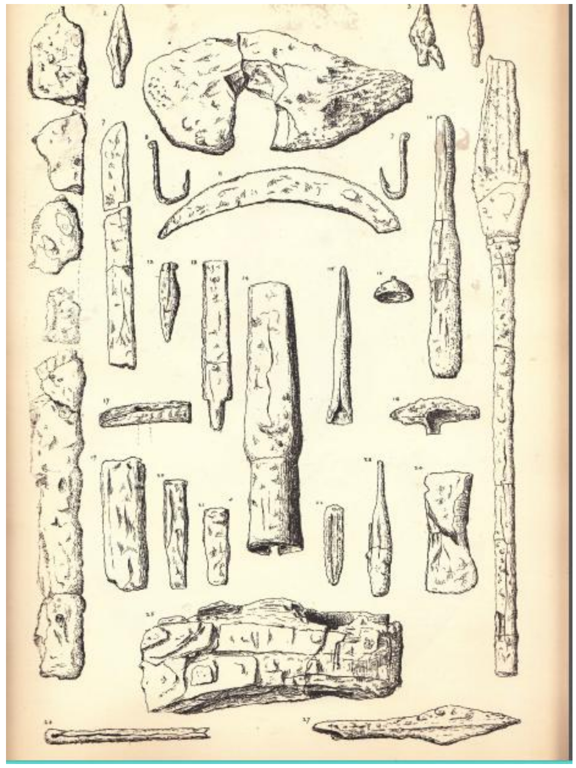


Figure 3. Naukratis Iron Implements, 6th century BCE (Petrie, 1886, PL XI).

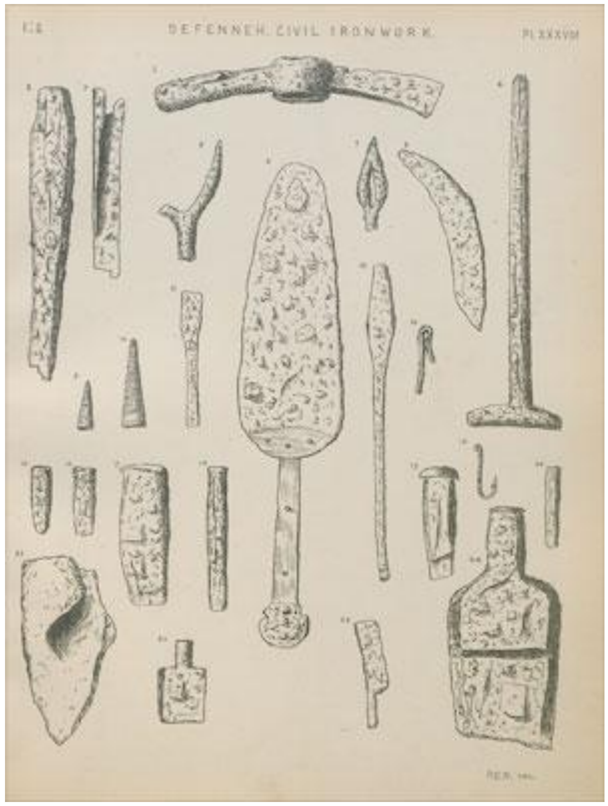
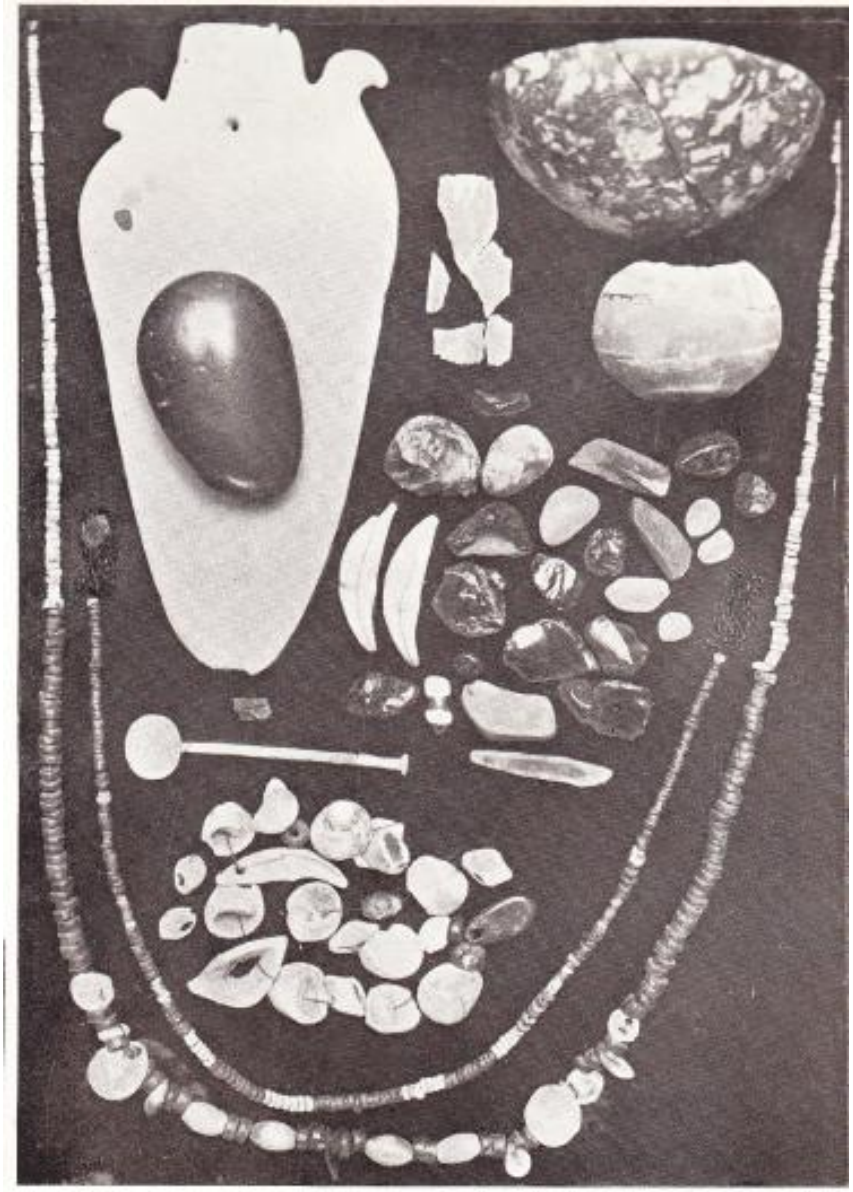


Figure 4. Tell Defenneh ironwork (Petrie, 1888, PL XXXVIII).

Figure 5. Iron bead from tomb 133. (Wainwright in Petrie et al., 1912).



1 : 2 TOMB GROUP, 133.

Figure 6. Grave goods from tomb 133 at el-Gerzeh. This grave contained the greatest number of beads from the site and the most diverse assemblage. Objects included lapis lazuli from Afghanistan, shells from the Red Sea and Mediterranean and a lump of red resin which may have been imported from Western Asia. A shield shaped palette with birds' heads was included. Stevenson argues that this grouping may have shown special knowledge of far away places (Stevenson, 2009, pp. 195-196; image from Wainwright in Petrie et al., 1912, pl. iv).

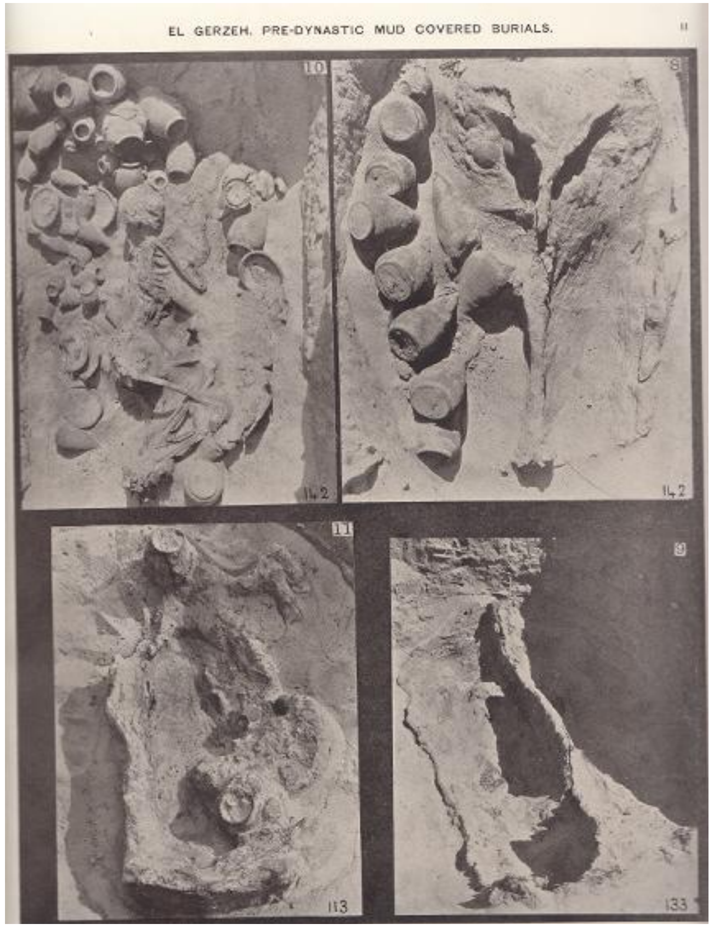


Figure 7. Mud covered burials at el-Gerzeh. Grave 133 is the grave in the lower right corner.

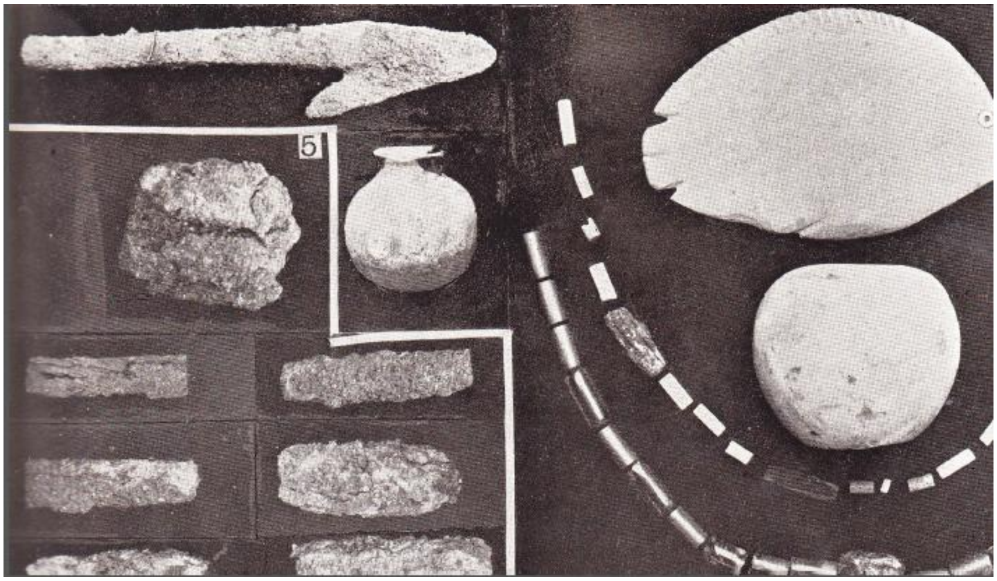


Figure 8. Grave goods from tomb 67 at el-Gerzeh. Seven tube-shaped iron beads under inset in lower left hand corner, labeled "5." Other objects include the only mace-head, harpoon and alabaster vase from the site. (Wainwright in Petrie et al., 1912). Note that the "Narmer Palette" (Figures 9 and 10) incorporates many of these symbols of power into the kingship at the time of unification.

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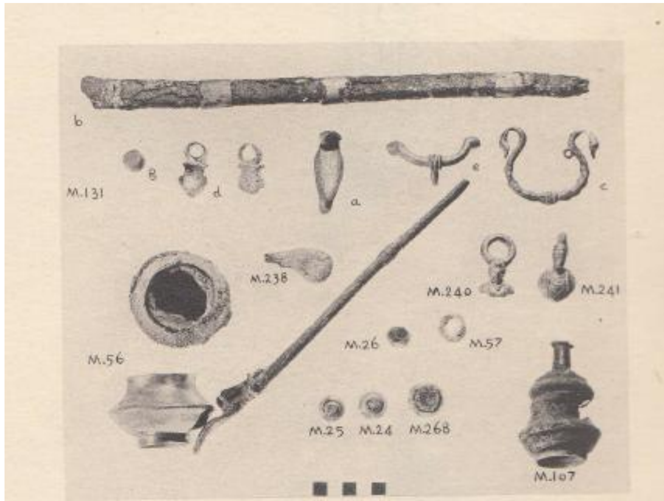
Figure 9. The king in his southern crown with his name written with hieroglyphs in the shape of a catfish and chisel in front of his crown. This hearkens back to the fish palette in Tomb 67 (Fig. 8). He holds the mace as an emblem of power just as he does on the reverse of the palette. Clearly Egyptian kingship built upon symbols that had been centuries in the making ("Narmer Palette," or Great Hierakonpolis Palette, Cairo Museum, Cairo J.E. 14716, C.G. 32169).

Figure 10. Detail of the obverse of the “Narmer Palette” which depicts the political unification of Egypt incorporates symbols seen in the iron-bearing Grave 67 at Gerzeh. The mace used to strike his foe, depiction of a harpoon, the fact that a palette is used for such an important ceremonial function as commemorating this event in addition to the hieroglyphs used for the king’s name are all reminiscent of the group of objects interred in the Predynastic burial.



STEELYARD, WEIGHTS AND INCENSE BURNERS

Figure 11. M 131 b is a steelyard of iron possibly of a "pagan" date from a room in an otherwise Coptic era building from Armant. It is located across the top (Mond & Myers 1940b, PL XXXI, M131 b). The term pagan probably refers to the Greco-Roman era c. 332 BCE-395 CE as the term was followed by other researchers like Latjar who use it in the same way.

Figure 12. Figure of Hephaistos from elite Roman Egyptian house of a councilman named Serenos from the edge of imperial influence at Amheida (ancient Trimithis) in the Dakhleh oasis. The Greek god of iron, volcanism etc. catches his wife Aphrodite in the act of adultery with Ares and ensnares both in a net so their indiscretion can become known. This painting displays the Greco-Roman influence within the domestic sphere during the time period the group of iron-workers of Armant were believed to be active. (Reproduced with the kind permission of Roger Bagnall, Director of NYU's excavations at Amheida.)

Appendix C

Table 5. 14 Museum Collections with Egyptian Iron Objects that Included a Date and Function

Museum	Function	
<u>Petrie Museum</u>		
Naqada I 1	Unclear	
Naqada II 3	100% Decorative	
Dyn 18 3	100% Utilitarian	
Dyn 22 1	100% Utilitarian	
Third Int Pd 1	100% Decorative	
Dyn 26 2	100% Utilitarian	
Late Period 7	100% Utilitarian	
Ptolemaic 14	86% Utilitarian	14% Decorative
Roman 278	85% Utilitarian	15% Decorative
Late Roman 47	17% Utilitarian	81% Dec. .02% unclear
Coptic 1	100% Utilitarian	
Byzantine 66	58% Utilitarian	17% Dec. 26% Religious
Islamic 6	100% Utilitarian	
Ottoman 5	100% Utilitarian	
435 Total Objects		
64% of dated iron was from Roman era		

Museum	Function
British Museum	
Old Kingdom 1	100% Utilitarian
18th Dynasty 2	10% Practical (Magico-religious) 50% Unclear
20th Dynasty 1	100% Utilitarian
New Kingdom 4	100% Utilitarian (25% Magico-religious)
Third Int. Pd 2	100% Utilitarian
Late Period 40	100% Utilitarian (8% Magico-religious of utilitarian")
Ptolemaic 9	100% Utilitarian (44% Magico-rel. of "utilitarian")
Greco-Roman 6	100% Utilitarian
Roman 56	89% Utilitarian (2% Magico-rel of "util.") 11% Dec.
Late Roman 1	100% Utilitarian
Coptic 34	85% Utilitarian 15% Religious
Early Byzantine 3	100% Utilitarian
Islamic 3	67% Utilitarian 33% Religious

162 total objects

35% of dated iron was from Roman era

Manchester Museum, UK	
Predynastic 7	86% Indeterminate (6 objects), 14% Decorative
Middle Kingdom 1	100% Decorative
New Kingdom 3	100% Utilitarian
Late Pd 30	97% Utilitarian 3% Decorative
Ptolemaic 2	100% Utilitarian
Roman 33	67% Utilitarian 33% Decorative
Coptic 8	63% Utilitarian (5 objects), 25% Dec. 12% Religious
Islamic 1	100% Utilitarian

85 Total Objects

39% of dated iron was from Roman era

Museum	Function	
<u>Kelsey Museum</u>		
Dynastic 1	100% Decorative	
Greco-Roman 2	100% Utilitarian	
Roman 32	100% Utilitarian	
Late Roman 2	100% Decorative	
Late Antique 1	100% Utilitarian	
Byzantine 12	100% Utilitarian	

50 Total Objects
Note the Late Roman is from a different site than all the Roman items, so we don't get to see if there was a transition there.
64% of dated iron was from Roman era

<u>Oriental Institute, Chicago</u>		
New Kingdom 3	100% Utilitarian	
Late Period 5	40% Utilitarian	60% Decorative
Ptolemaic/Roman 12	75% Utilitarian (.08 % magico-religious among those) 25 % Decorative	
Roman 5	40% Utilitarian	60% Decorative
Coptic 9	100% Utilitarian	
Byzantine 2	100% Decorative	

36 Total Objects
33% of total dated iron from Ptolemaic/Roman era

<u>Museum of Fine Arts, Boston</u>	
Late Period 5	100% Utilitarian
Ptolemaic 2	100% Decorative
Greco-Roman 1	100% Utilitarian (Magico-religious)
Roman 2	100% Decorative
Coptic 2	100% Utilitarian

Total 12 objects
42% of total dated iron was from Late Period

Museum	Function
Brooklyn Museum	
Third Int. Period 1	100% utilitarian
Late Period 1	100% utilitarian
Roman 5	80% utilitarian 20% decorative
Coptic 4	50% decorative 50% religious
11 items total	
45% of total dated iron was from Roman era	
University of Pennsylvania Museum	
Third Int. Pd. (D. 22) 3	100% Utilitarian
Late Pd (D. 26) 1	100% Utilitarian
Greco-Roman 1	100% Decorative
Roman 1	100% Decorative
Coptic 2	50% Utilitarian 50% Decorative
8 total objects	
Cleveland Museum of Art	
Roman 4	100% Decorative
4 Total Objects	
Fitzwilliam Museum	
Ptolemaic 2	100% Decorative
2 Total Objects	
Peabody Museum, Yale	
Roman 2	100% Utilitarian
2 Total Objects	

Museum	Function

Allard Pierson Museum, Amsterdam

Coptic (or later) 1	100% Religious
1 Total Object	

Kunsthistoriches Museum, Vienna

15th c. 1	Functional,
1 Total Object	ceremonial
	or both?
	(Mamluk sword)

38% total dated iron Coptic era

Table 6. Bronze and Iron Totals by Museum (Iron/Bronze for Each Era)

Museum	Dates		
	Predynastic	Old Kingdom	Middle Kingdom
Allard Pierson Museum, Amsterdam	0/0	0/0	0/0
British Museum	0/0	1/7	0/35
Brooklyn Museum*	0/1	0/5	0/14
Cleveland Museum of Art	0/0	0/0	0/2
Manchester Museum, UK	7/0	0/5	1/7
Metropolitan Museum of Art, NY	0/0	0/9	1/14
Museum of Fine Arts, Boston	0/7	0/44	0/47
Fitzwilliam Museum, UK	0/0	0/1	0/0
Kelsey Museum	0/0	0/0	0/1
Kunsthistorisches Museum, Vienna	0/0	0/0	0/0
Oriental Museum, Chicago	0/0	0/12	0/16
Petrie Museum	4/1	0/1	0/23
UPenn	0/0	0/0	0/0
Yale (Peabody Museum)	0/0	0/0	0/1

Museum	Dates		
	New Kingdom	Ptolemaic	Roman
Allard Pierson Museum, Amsterdam	0/1	0/7	0/17
British Museum	4/144	9/*255	63/*279
Brooklyn Museum	0/80	0/170	5/82
Cleveland Museum of Art	0/12	0/15	4/5
Manchester Museum, UK	3/121	2/30	33/81
Metropolitan Museum of Art, NY	2/459	11/361	11/13
Museum of Fine Arts, Boston	0/51	2/66	2/245
Fitzwilliam Museum, UK	0/5	2/31	0/9
Kelsey Museum	0/0	2/418	35/2988
Kunsthistorisches Museum, Vienna	0/0	0/0	0/0
Oriental Museum, Chicago	3/332	12/82	5/76
Petrie Museum	3/191	14/42	325/289
UPenn	0/76	1/143	1/2212
Yale (Peabody Museum)	0/8	0/5	2/8

* Number had to be estimated

	Coptic/Byzantine	Islamic
Allard Pierson Museum, Amsterdam	01/2	0/0
British Museum	37/66	3/16
Brooklyn Museum*	4/20	1/1
Cleveland Museum of Art	0/0	0/0
Manchester Museum, UK	8/41	1/0
Metropolitan Museum of Art, NY	57/13	4/8
Museum of Fine Arts, Boston	2/17	0/0
Fitzwilliam Museum, UK	0/2	0/7
Kelsey Museum	12/13	0/33
Kunsthistorisches Museum, Vienna	0/0	0/0
Oriental Museum, Chicago	11/18	0/30
Petrie Museum	67/22	6/7
UPenn	2/14	1/0
Yale (Peabody Museum)	0/4	0/0

Table 7. Iron Objects from Petrie Museum

Time Period (Petrie's)	Number of Objects	Percentage of Decorative/Utilitarian/Religious Objects		
Naqada II	1	100% Decorative		
Dyn 18	3	100% Utilitarian		
Dyn 22	1	100% Utilitarian		
Dyn 26	2	100% Utilitarian		
Third Int Pd	2	50% Decorative	50% Unclear	
Late Period	7	100% Utilitarian		
Ptolemaic	14	86% Utilitarian	14% Decorative	
Roman	278	85% Utilitarian	15% Decorative	
Late Roman	47	17% Utilitarian	81% Decorative	.02% Unclear
Coptic	1	100% Utilitarian		
Byzantine	66	58% Utilitarian	17% Decorative	26% Religious
Islamic	6	100% Utilitarian		
1000 AD X-Group	1	100% Utilitarian		
Ottoman	5	100% Utilitarian		

Height of Iron Production = Roman era

Percentage decline in iron production between Roman era and Late Roman era = 83.094% decrease at Petrie Museum.

Decline in utilitarian iron between Roman era and Late Roman era= 69% decrease at Petrie Museum.

Sites Defenneh and Naukratis are included although only a small number of goods from each site were part of this database. Nonetheless, they did support the overall pattern. At Naukratis there were 7 items from the Ptolemaic era and 4 from the Roman era, all of which were utilitarian. From Defenneh there were 5 items from the Late Period. The site of Oxyrhynchus alone produced 44 objects solely from the Roman era, 100% of which were utilitarian.

Table 8. Iron Objects By Location From Petrie Museum (Only Those Information Providing Time Periods Were Included In Tallies In Previous Table)

Location	Number of Objects	Time Period	Use (Percentage Utilitarian)
Abydos	2	No Time Pd	
Arthribis	3	Roman Pd	100% Utilitarian
	2	Byzantine Pd	100% Utilitarian
Asyut	1	No Time Pd	
Badari (Tomb 3116)	1	Late Roman Pd	Unclear
Ballas	1	Naqada Tomb 1666	Unclear
Cairo	1	No Time Pd	
Defenneh	5	Late Pd	100% Utilitarian
Fayum Governate	8	No Time Pd	
	1	Roman	100% Utilitarian
	3	Byzantine	100% Utilitarian
Gerzeh	3	Naqada II	100% Decorative
Gurob	1	Ptolemaic	100% Decorative
	15	Roman Pd	40% Utilitarian
	12	Late Roman Pd	41% Utilitarian
	2	Byzantine	100% Utilitarian
Kafr Ammar	1	3rd Int Pd	Unclear
Koptos	1	No Time Pd	
Lahun	8	Roman Pd 8	100% Decorative
	28	Late Roman Pd	0.07% Utilitarian
	4	Byzantine	50% Utilitarian
Medinet el-Fayum	1	No Time Pd	

Location/Number of Objects		Time Period	Use (Percentage Utilitarian)
Memphis	5 Ptolemaic Pd		100% Utilitarian
	19 Roman Pd		100% Utilitarian
	35 No Time Pd		
Meroë:	6 No Time Pd		
Naukratis	1 Late Pd		100% Utilitarian
	7 Ptolemaic		100% Utilitarian
	4 Roman		100% Utilitarian
Oxyrhynchus'			
	44 Roman		100% Utilitarian
Qanadla	1 Byzantine		100% Utilitarian
Qau	6 Roman		83% Utilitarian
	2 Byzantine		100% Decorative
	1		No Time Period
Qsr Ibrim	1 Mid 1st m.		100% Utilitarian
Cemeteries	50		No Time Pd
Ramesseum	2 Dyn 22		100% Utilitarian
Rifeh	2 Roman Pd		50% Utilitarian
	2 Byzantine		100% Utilitarian
Shurafa	13 Roman Pd		100% Utilitarian
Tehneh	2 Roman Pd		100% Utilitarian
Tell el Yehudiyeh	1 Dyn 26		100% Utilitarian
Wushym	1 Roman Pd		100% Utilitarian

Table 9. Iron Objects with No Locations but Including Time Periods from Petrie Museum

Time Period	Number of Objects	Percent Utilitarian/Decorative
Dynasty 18	3	100% Utilitarian
Third Int Pd	1	100% Decorative
26th Dyn	1	100% Utilitarian
Assyrian Pd	13	100% Utilitarian
Late Pd	6	100% Utilitarian
Ptolemaic Pd	1	100% Decorative
Roman Pd	161	84% Utilitarian
Late Roman Pd	6	83% Utilitarian
Coptic	1	100% Utilitarian
Byzantine	50	34% Religious/52% Utilitarian/14% Decorative
Islamic	6	100% Utilitarian
Ottoman	5	100% Utilitarian

Appendix D

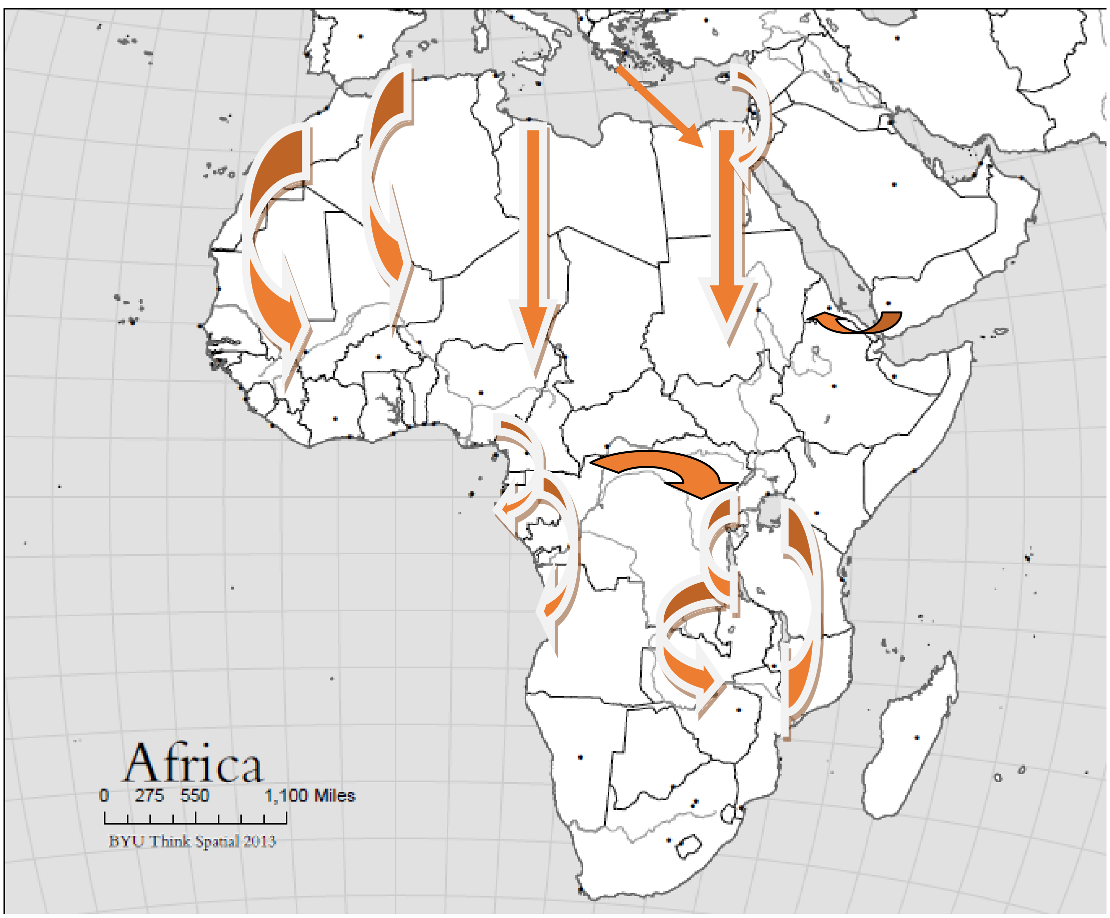
Map 5.

Examples of postulated routes and origins of the spread of ironworking:

(Outline map provided by courtesy of BYU Geography Dept.)

By 500 BCE iron working had spread throughout sub-Saharan Africa. The origins of the technology (indigenous or otherwise) remain unknown.

The origins of ironworking are unknown in many cases although some facts about the direction of its movement can be determined. In other cases even these routes are debated.



Appendix E

General Chronologies

Comparative Chronology of Egypt and Canaan (Levant) to Roman Period, (Egypt continues to Ottoman era).

(Cohen, 2004; Warburton et al., 2006)

Egypt	Canaan (Levant)
Naqada I-II 4000-3100 BCE (Predynastic)	Chalcolithic 4500-3500 BCE
Naqada III 3100-2950 BCE (Predynastic)	Early Bronze Age I A-B 3500-3000
Early Dynastic or Archaic Period 2950-2575	Early Bronze Age II 3000-2700
Old Kingdom 2543-2120	Early Bronze Age III 2700-2200
1st Intermediate Period 2118-1980	Early Bronze Age IV/Middle Bronze Age I 2200-2000
Middle Kingdom 1980-1760	Middle Bronze Age II A 2000-1750
2nd Intermediate Period 1759-1539	Middle Bronze Age B 1750-1550
New Kingdom 1539-1077	Late Bronze Age I 1550-1400 Late Bronze Age II A 1400-1300 Late Bronze Age II B 1300-1200
	Iron Age I A 1200-1150 Iron Age I B 1150-1000
Third Intermediate Period 1076-723	Iron Age II A 1000-900 Iron Age II B 900-700 Iron Age II C 700-586
Late Period 722-332	Babylonian & Persian Period 586-332
Hellenistic Period 332-30	Hellenistic Period 332-37
Roman Period 30BCE-395 CE	Roman Period 37 BCE-324 CE

"Greco-Roman Period" in Egypt*
extends from period of Hellenistic rule
to the Roman era, 332 BCE-395 CE

Coptic = material culture from Christian Egypt which appeared openly after the 3rd c. BCE (although Christians were evidently in Egypt from 1st century forward) and began to be suppressed around 1250 CE by the Mamluks (Innemée, 2014).

Byzantine= designation for material that overlaps with Coptic. The actual era extended from c. 330 through 642 (Arab conquest) in Egypt although the time period lasted until 1453 elsewhere (Brooks, 2009).

Islamic= 642-1517 CE first period of Islamic rule, but Islamic art is the material culture (Ettinghausen, Grabar & Jenkins-Madina, 2001).

Ottoman era 1517-1914 CE (Falola, 2002).

*Museum collections use different terminologies for the last overlapping periods. For the Hellenistic periods terms include "Hellenistic" and "Ptolemaic" or fall in an intermediate "Greco-Roman" category. Roman material can include "Greco-Roman," "Roman," "Late Roman," "Late Antique," or the chronological dates in varying forms ("third century," etc.).

Hittite Chronology.

(Harl, K., 2015; Bentley & Ziegler, 2011, pp. 43-44; "Anatolia," 2016)

7,000-6,000 BCE	Çatal Hüyük. Neolithic farming and stockbreeding begin in the region. Houses built of sun-dried brick.
7,000 BCE	Chalcolithic. Metallurgy was beginning.
3,500 BCE	**Beginning of Hittite Bronze Age** (corresponds to Egyptian Predynastic).
2,400-2,000 BCE	Hittite speaking people first arrive (Neshites, Luwians and Palaites).

2,000 BCE	**Middle Bronze Age** Hittites begin fitting chariots with spoked wheels creating a lighter and less cumbersome vehicle ideal for battle that ultimately changes warfare throughout much of continental Eurasia (Bentley & Ziegler, 2011, p. 44).
1,900	Hittite-Assyrian silver trade
1,650- 1,500 BCE	"Old Kingdom" Hattusaš is made capital, kings include Labarnaš I, Hattušiliš I, Muršiliš I and Telipinus (last king).
1595 BCE	Hittites sack Babylon which makes them the dominant power of southwest Asia for the next few centuries.
1450-1200 BCE	Authority extends fromn Anatolia to northern Mesopotamia and Syria to the south as far as Phoenicia.
1500-1420 BCE	Hittite Civil Wars which coincide with rise of Mitanni and the Egyptian "New Kingdom" or "Age of Empire," (Dynasty18) which saw their greatest expansion.
1500-1400 BCE	Period known as the "Middle Kingdom" by some historians.
1400-1180 BCE	**"Hittite New Kingdom" or "Empire"** which saw the conquest of the Mitanni and North Syria. Important kings include Šuppiluliumaš I, Muršiliš II, Muwatalliš, Hattušiliš III and Tudhaliyaš IV.
1300 BCE	**Beginning of their iron metallurgy**. The Hittites are believed to have caused a great diffusion of iron production, especially after their craftsmen were dispersed after the collapse of their kingdom c. 1200 BCE (Bentley & Ziegler, 2011, p. 44).
1275 BCE	Battle of Kadesh, one of the first battles in history wherein a tactical description of the events has survived in the historical record.

c. 1190 BCE	**Hattusaš was sacked & Hittite Empire Collapses**
1150- 711 BCE	Neo-Hittite kingdoms appear in Syria.

General Time Line for ancient Greece.

(Sienkewicz, 2007, p. 955; Bentley & Ziegler, 2011, chapter 10; Judge & Langdon, 2012, p. 162).

c. 2600 BCE- 2200 BCE	Beginnings of Minoan civilization. Sophisticated society that built most notable palace at Knossos. Scholars named them after the legendary king Minos who ruled the island.
2500 BCE	Beginnings of Helladic civilization on mainland Greece.
2200 BCE	Indo-Europeans begin arriving in Greece. Their movements believed not to be a mass migration, but an incremental process of movement into the area. Their center Mycenae gives them their name Mycenaean.
2200-1450 BCE	Crete was the most important center of commerce in the Mediterranean using ships of Phoenician design. Their influences and contacts included areas from Egypt to Sicily.
1500- 1100 BCE	Mycenaeans overpower Minoans (taking over the palace at Knossos c. 1400 BCE). They expand their influence beyond the Greek peninsulas for first time.
1500 BCE	Volcano on Thera destroys most of coastline of Crete.
1250 BCE	Sienkewicz dates the fall of Troy to this date but notes that the Greeks believed it occurred in 1184 BCE (p. 955). Bentley & Ziegler date it to 1200 BCE (2011, p. 191).
1100-800 BCE	"[C]haos reigned throughout eastern Mediterranean" Bentley & Ziegler, 2011, p. 191) including invasions and civil disturbances. This is also known as the "Greek Dark Ages" and is considered by some authors including Bentley & Ziegler to be the backdrop for Homer's epic poetry (p. 191).
1100- 1000 BCE	Aegean "Sea Peoples" begin their migration to western Anatolia.

1,000 BCE	Greeks develop alphabet after Semitic examples that first appeared in Syria.
800 BCE	The "poleis" or city-states first develop.
750-725 BCE	The Iliad and the Odyssey are composed.
800-350 BCE	The Age of "Classical Greece."
621 BCE	Draco puts forth legal code in Athens.
594 BCE	Solon puts forth his reforms.
431-404 BCE	Peloponnesian War.
336-323 BCE	Alexander the Great reigns bringing about the beginning of the Hellenistic era.
323-30 BCE	Hellenistic era or "[E]ra of the Hellenistic kingdoms" (Judge & Langdon, 2012, p. 162).

Timeline of African Ironworking (and some events in Egyptian history).

Since there is no consensus for the periodization of African history, authors have to use the more common dates based on radio carbon dating and historical documents. Most dates before the 15th century are approximated by Falola and all cited sources (Falola, 2002, pp. xiii-xx; "Hyksos," 2016; Bentley & Ziegler, 2011; Judge & Langdon, 2012).

40,000 BCE	Prehistory: Homo sapiens sapiens ("modern man") emerged with the ability to talk and many other useful adaptations.
58,000-13,000 BCE	Homo sapiens reach nearly every area of the biosphere (habitable areas).
5000 BCE+	The Agricultural Revolution occurs, with enormous consequences for African civilization since the first inhabitants were hunter gatherers. Some scholars theorize that farmers and hunter gatherers competed for resources with one another. Early states such as Egypt were in their formative phase.
4000 BCE	Metalworking (copper) appears in Sinai.

3100 BCE	Egypt develops a centralized government as the kingdoms of Upper and Lower Egypt were unified creating the first territorial state in history. This event may be commemorated on the so-called "Narmer Palette."
1800 BCE	North Africa becomes the site of numerous developments including the settlement of cities, rise of agriculture and centralized forms of political authority.
1630 BCE-1523	The Hyksos invade Egypt. The immigrants brought horses, chariots, the compound bow and superior metal (bronze) weapons with them.
1000 BCE	The Berber civilization appears in North Africa. Trans-Saharan movements of horses and donkeys begin to connect regions.
950 BCE	The Nubians (Kush) regains independence from Egypt. Palestine/the Levant also breaks away from the Egyptian empire.
700 BCE	Camel arrives in North Africa (Egypt and Sudan) from Arabia.
670 BCE	The Assyrians (Esarhaddon) invade Egypt which causes the Kushite kings to withdraw to Nubia on a permanent basis.
500 BCE	The Bantu had acquired smelting technology to forge weapons and tools. **Ironworking spreads to west, central, eastern, and southern Africa due to the Bantu Migrations. The Nok of Nigeria are an example of an iron-using culture from this expansion.**
400 BCE	The population of sub-Saharan Africa reaches approximately 3.5 million people.
400 CE	Settlement of Jenne-jeno in modern Mali emerges as center of iron production and trade.
4th or 5th c. CE	Ghana becomes a state.
800 CE	Banana cultivation had spread through continent and populations reach 17 million. Jenne-jeno becomes the major commercial center of west Africa.
332 BCE-30 BCE	Native Egyptian rule ends when Alexander the Great invades Egypt and his general establishes the Ptolemaic dynasty which lasts for 300 years until the death of Cleopatra VII when Roman rule begins.

146 BCE	The Romans conquer Carthage and began their control of the coastal parts of North Africa .
100 CE	The kingdom of Aksum is established.
300	**The knowledge of ironworking is now firmly established in many parts of Africa**.
640	An Arab army enters Egypt after which follows the spread of Islam in North Africa.
1,000 CE	The Bantu approach the limits of their expansion. For the next several centuries they would build societies on the foundations of the earlier communities that had migrated throughout the region. Population of sub-Saharan Africa reaches in excess of 22 million people. The population pressures cause the rise of local kingdoms and conflict over resources. Iron weapons and tools are a clear advantage for those who have them.
1250-1517 CE	Mamluk soldier kings rule in Egypt.
1400 CE	Centralized kingdom known as Kongo had emerged in Central Africa.
1811	Muhammad Ali achieves power in Egypt.
1853–79	Egypt expands.
1882	Egypt is conquered by the British.
1914	The First World War begins setting off another period of major transformation across the continent.